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Generic Environmental Impact Statement

Air Force Low Altitude Flying Operations

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Generic Environmental Impact Statement for Air Force Low Altitude Flying Operations

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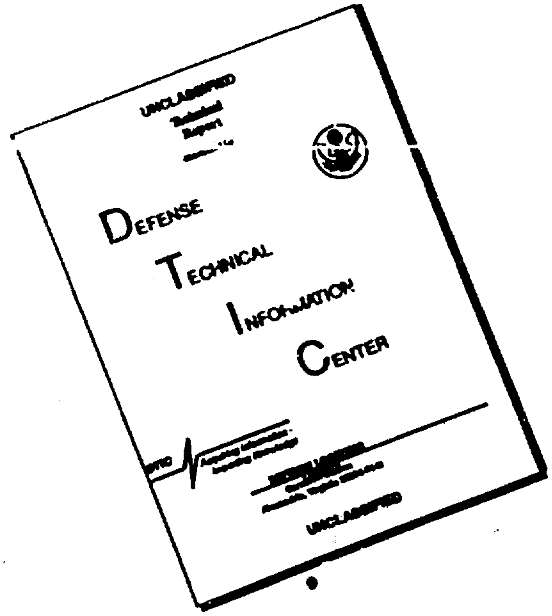

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VOLUME I

GENERIC ENVIRONMENTAL IMPACT STATEMENT FOR AIR FORCE LOW ALTITUDE FLYING OPERATIONS

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EXECUTIVE SUMMARY

I. INTRODUCTION

The Air Force uses approximately 1,000 designated blocks of airspace in the continental United States (including Alaska) for subsonic low altitude training and testing purposes. For environmental assessment purposes, the maximum ceiling for low altitude airspace is 3,000 ft above ground level (AGL). Minimum altitudes may be only a few hundred feet AGL and sometimes as low as 100 ft. The nature of the airspace (in terms of length, width, altitudes, location, time of operation, etc.) varies to accommodate the types of mission to be flown and the resources of the user. Specifically, airspace dedicated to Air Force low altitude flying operations is categorized as military training routes (MTRs), slow-speed, low altitude training routes (SRs); military operations areas (MOAs); restricted areas (RAs); and low altitude tactical navigation areas (LATNs). MTRs are classified as either Instrument Routes (IR) or Visual Routes (VR).

IR routes are airspace corridors established by the Federal Aviation Administration and the Air Force to provide military aircrews with low altitude navigation and tactical training under a variety of conditions. MTR airspace is required for aircraft operating at speeds exceeding 250 knots below 10,000 ft and typically range in length from 300 to 1,500 miles with corridor widths of 4 to over 70 miles. SRs are similar to MTRs where aircraft are allowed to operate at or below 1,500 ft AGL at speeds of 250 knots or less. MOAs are airspace assignments of defined vertical, horizontal, lateral, and temporal dimensions established outside positive control areas (below 18,000 ft mean sea level) to separate certain military aircraft activities from civilian aircraft. MTRs and MOAs are reserved for military training use only when scheduled. The military does have priority in scheduling the airspace within a MOA but must compete with other users. MOAs generally cover several thousand square miles of land. RAs are assigned airspace in which non-participating aircraft are prohibited from use during designated times unless advance permission is given by the controlling or using agency. These areas are often associated with test and gunnery ranges which would pose a hazard to nonparticipating aircraft. This category of airspace also allows flights at speeds in excess of 250 knots below 10,000 ft and is one in which nonmilitary aircraft are excluded from use when the airspace is active. RAs may span from less than 100 to several thousand square miles of land. LATN areas permit random navigation training for aircraft traveling at speeds of 250 knots or less and operating at or below 1,500 ft AGL.

In 1986, the Air Force controlled 599 low altitude routes, 126 low altitude MOAs, and 88 low altitude RAs over the continental United States. This airspace is generally found in a rural setting. Combined, these training airspaces covered almost 1 million sq. miles, or 25% of the total land area of the 49 states. The most heavily utilized airspaces, MOAs, and RAs, covered only approximately 5% (MOAs, 4.3%; RAs, 0.7%) of the continental United States. Usage of airspace over the continental United States is segmented in terms of flight scheduling and altitude structure such that only a portion of this land area is affected at one time.

Air Force low altitude flying operations may be intrusive events for areas under the airspace, concern has been expressed by some agencies and members of the public about their environmental effects. These concerns range from social effects such as annoyance, sleep disturbance, and interference with peaceful rural settings to adverse health effects (e.g., hearing loss), damage to fragile structures of historical significance, disturbance of wildlife, and many others. There is increasing concern over both the acquisition of new airspace and the maintenance/modification of existing airspace for Air Force training operations. To ensure that environmental factors are appropriately considered in decision making for Air Force proposals to establish or modify subsonic low altitude airspace, environmental impact assessment documentation is prepared consistent with the National Environmental Policy Act of 1969 (NEPA) and Air Force Regulation (AFR) 19-2. The Air Force determined that its environmental impact assessment process (EIAP) for low altitude flying would benefit from a consolidated, in-depth analysis of issues common to low altitude flying. This objective led to the development of this document, the Generic Environmental Impact Statement (GEIS) for low altitude flight operations. Its intent is to

- provide generic analyses of and conclusions about the environmental impacts common to Air Force low altitude flying operations;
- provide a broad forum in which the public and interested state and federal agencies can participate in development of the GEIS;
- serve as a cost-effective reference document for future Air Force NEPA analyses by describing appropriate data, findings, analytical methods, and formatting procedures; and
- facilitate greater consistency in the Air Force's EIAP in future analyses.

II. ISSUES IDENTIFIED FOR CONSIDERATION

The formal scoping process for this GEIS included a Notice of Intent published in the *Federal Register* and public meetings at eleven locations in the continental United States. Both written and verbal comments on the scope of the GEIS and potentially significant issues to be analyzed were solicited and received from members of the public, interest groups, and governmental agencies. Comments were also solicited and received from Indian tribes and technical experts in relevant scientific disciplines. Table ES.1 provides a summary of issues identified through the scoping process. These issues were the focus of this GEIS.

Table ES.1. GEIS public scoping comments by generic resource

Generic resource	Concerns/comments
Airspace Use and Management	• airspace is a finite resource • military has too much airspace • should use current airspace more intensively • address cumulative airspace issues of all military
Social	• annoyance • safety of people on ground • intrusion into living and working environment • sleep disturbance • frightening children and adults • interference with communication • interference with peaceful rural settings
Noise	• physiologic reaction • startle reaction • learning disabilities • low birth weight babies • asthma
American Indians	• interference with rural lifestyle and subsistence living • domestic livestock • wildlife • archaeological sites • impact to religious sites and ceremonies • tribal sovereignty • family quality of life
Structures	• damage to fragile historically significant structures • cracking and crumbling of walls and ceilings • cracking of windows • possibility of landslides or avalanches
Wilderness and Parks	• disruption of visitor enjoyment • conflict with wilderness character • interruption of hunting and fishing activities
Wildlife	• interruption of nesting and rearing of young • frightening wildlife away from its habitat • interference with migration • disruption of feeding
Livestock and Poultry	• reduced productivity • interference with breeding • fright responses • interference of military with farmers private flying (e.g., crop dusting, livestock inspection)
Air Quality	• types of emissions • quantities of emissions • effect of emissions on humans or livestock
Health and Safety	• fast and low flying planes are difficult to see and avoid • difficulty in securing information about military operations from traffic controllers • accidents • lasers • non-ionizing radiation

III. APPROACH TO ASSESSMENT

Once the appropriate resource were identified through scoping, the overall methodology used to examine the potential issues and to further the objectives of the GEIS effort consisted of the following elements:

- data development,
- case study evaluations,
- generic resource assessments, and
- assessment of cumulative impacts.

Obtaining new information about the potential issues (or resource categories) was considered important because the existing information was judged to be of varying quality and applicability to low altitude flying. Consequently, the GEIS accumulated reliable existing information about impacts, developed new supporting information to supplement that already available, and developed a system for making this information available for future use in a consistent fashion. Some of the salient topics and data-gathering and development methods included airspace data describing the Air Force's inventory of low altitude airspace and the scheduled flying operations in that airspace; the social impacts data obtained through 721 interviews with people living or working under selected low altitude airspaces and supplemented with over 500 interviews with local officials and newspaper editors in these areas; information obtained from a specifically commissioned national survey on the relative value people put on wilderness and parks areas; an air pollutant dispersion model for low altitude aircraft; a model for estimating structural impacts of low altitude flying operations; and the results of many interviews with knowledgeable state and federal officials regarding impacts for most of the resource categories.

The case-study approach was used as the primary means of gathering information about impacts of low altitude flying operations. Such an approach provides a realistic and convenient means of portraying the environmental impacts. Twelve airspaces were selected for analysis through a sampling technique applied to all Air Force subsonic, low altitude airspace. The sampling technique was designed to ensure objective selection of a wide variety of low altitude airspaces. This number of airspaces does not constitute a statistically representative sample, but it does provide a manageable number of cases that adequately portray the range of impacts that occur from the great majority of the Air Force's low altitude flying operations.

A generic assessment was performed for each of the ten resource categories (Table ES.1) potentially affected by low altitude flying operations. The assessments examine the existing scientific literature and identify findings that are considered to be relevant to Air Force low altitude flying operations. The results of analyses, including the case studies and special research tasks are also included. Finally, a classification system for determining the levels of impacts to certain resources is prepared for use in assessments of new low altitude airspace proposals.

The final element of the GEIS assessment methodology consisted of a cumulative impact assessment as defined by Council on Environmental Quality regulations [CEQ (40 CFR 1508.7)]. Consideration is given to the cumulative or concurrent impacts that occur from low altitude flying operations in which two or more airspaces affect the same sensitive resource or "receptor," such as a person, animal, or structure.

IV. RESULTS

A principal objective of the GEIS is the development of specific guidance for analyzing the environmental impacts of low altitude airspace proposals and for preparing appropriate environmental documentation. Volume II, the GEIS *EIAP Guide*, provides a framework for conducting future airspace environmental assessments. It outlines specific procedural and analytical steps to assist environmental planners and airspace managers in the preparation of consistent EIAP documents.

The following is a summary of the impacts expected from low altitude flying as a result of the GEIS research effort. Validation of these impacts was provided by independent assessments of 12 case study airspace locations throughout the United States. It should be noted that any reference to the national exposure of a particular resource to low altitude flying operations does not imply sustained aircraft activity. Military airspace usage is multidimensional (length, width, altitude, and time) such that only a portion of the land area is affected at any one time.

Airspace Impacts

Because airspace is considered to be an environmental resource, the FAA evaluates airspace impacts when it approves and establishes an airspace. The FAA and Air Force cooperate in airspace management. Pursuant to the Federal Aviation Act of 1958, the FAA has final authority in use and management of the nation's airspace resource. This includes jurisdiction in approving Air Force proposals for MTRs, MOAs, and RAs and in managing the airspace for competing users once it is established.

In 1986, the Air Force operated in 599 MTRs and SRs, 126 MOAs, and 88 RAs in U.S. low altitude airspace. Combined, these training airspaces covered almost one 1 million sq. miles, or 25% of the country's surface, including Alaska. However, the most heavily utilized airspaces, MOAs and RAs, covered only 4.3% and 0.7% of the continental U.S. (CONUS) land area respectively. Air Force routes and drop zones covered over 818,000 square miles, and Air Force MOAs and RAs covered 155,000 and 25,000 sq. miles, respectively.

In recent years, concern has been expressed over the amount of low altitude airspace allocated to military operations. Such airspace is a finite resource with multiple users, including ranchers, farmers, federal and state natural resource agencies, crop dusters, oil and gas companies, general aviation, hunters, and tourists. (The commercial airline industry generally does not require low altitude airspace except near airports where take-off and approach patterns occur at low altitude.) It is general aviation traffic, such as private planes and governmental agency aircraft, that may be affected most because these flights are often conducted below 3,000 ft AGL and under VFR conditions. When unusual civilian flight activity, such as wildlife survey flights or fire detection/fighting flights occur in an area, the agency conducting those flights, if it feels a significant hazard exists, has the responsibility for notifying the appropriate FAA Air Route Traffic Control Center (ARTCC). The ARTCC or respective FAA Flight Service Station issue notices to airmen (NOTAM) that contain information on the civil/military aviation use in the area. Agencies or individuals desiring scheduling information regarding military low altitude operations in a particular area can secure such information by contacting the nearest FAA Flight Service Station.

Although the amount of airspace designated for military use seems substantial, most of it is not being used for Air Force low altitude flying at any one time. When airspace is not being used by the Air Force, the FAA treats the airspace as if it does not exist. Except for approximately 25,000 sq. miles (0.7% of CONUS land area) of RAs, joint use by commercial and general aviation aircraft under VFR is permitted while the airspace is being used by the Air Force. Military aircraft engaged in low altitude flight operations are under many of the same flight rules as civilian aircraft. The same 500-ft minimum separation, requirement to yield right of way to the aircraft least able to maneuver, and "see and avoid" rules apply to both civilian and military aircraft. Civilian aircraft under IFR will be routed around sectors of military activity when reserved airspace is active. Thus, although the use of low altitude airspace by the Air Force may require civilian use of restrictive flight rules, very little of the airspace is actually denied to civil aviation.

Social Impacts

Because of the frequency with which the issue of social impacts was raised at public scoping meetings and through other scoping procedures, this issue is among the major concerns of the GEIS (see Vol. IV, Appendix B). Several methods of investigation were used in the analysis of social impacts, most notably a literature review, face-to-face interviews with over 700 people located under case study airspaces, telephone interviews with over 500 key informants (local officials and newspaper editors) in communities under these airspaces, and telephone interviews with airspace schedulers and military public affairs personnel. The principal products of this research are (1) a description of the nature and magnitude of impacts generated by the flights; (2) an understanding of the social characteristics and flight parameters associated with these impacts; and, as a result of this understanding, (3) an indication of what adverse impacts might be mitigated in the airspace planning process, or during or after the implementation of a new or changed airspace.

GEIS research findings indicate that the social impacts of Air Force low altitude flight operations consist of annoyance, disruption of activities, disturbance of the young in group facilities, and economic losses to individuals from livestock disturbance. These impacts may affect both individuals or groups of individuals. Impacts to individuals include annoyance and interrupted activities. For people interviewed face-to-face, the level of impact generally was moderate; nearly one-third of the survey respondents were highly annoyed with one or more aspects of the flights, and almost one-fourth reported being disturbed while sleeping or during three or more non-sleep activities.

Although relatively large numbers of individuals report that they are highly annoyed or that many activities are interrupted, these impacts seldom spur actions other than informal complaints. Therefore, these impacts may not have much importance in the overall scheme of peoples' lives. Evidence that the impacts of low altitude flights may not affect people strongly includes the following: (1) there were very few respondents (4 out of 721) who spontaneously mentioned the flights as something they dislike about their area; (2) nearly 80% of the respondents either supported the low altitude flights (43%) or neither supported nor opposed them (36%); (3) about 61% of the respondents reported liking some aspect of the flights; and (4) only 14 respondents (1.9%) said they had complained about the flights formally. Similarly, flights may affect a large number of people but may not cause community disruption.

Among the actions people can take in response to Air Force low altitude flight operations are registration of complaints (formally and informally), group formation, and other displays of displeasure. Vehement social responses to flights have been reported in such places as Dixie Valley, Nevada, and in Europe. Analyses of data from face-to-face and key informant interviews showed no such highly charged social responses to Air Force training activities in the case study airspaces.

However, lesser responses to the flights did occur in the case study sites. While nearly one-quarter (23%) of those surveyed said that they complained informally to friends or family members, only two percent reported that they had complained formally to authorities about the flights. About one-quarter of the local officials and newspaper editors contacted reported receiving complaints about low altitude flights. Whether these complaints were in response to Air Force activities in case study airspaces or other low altitude airspaces in the vicinity is unclear.

It is important to note that flights may affect people without causing overtly observable responses. As mentioned earlier, low altitude training activities may cause impacts such as annoyance, activity disruption, economic difficulties from livestock disruption, and disruption of young people in group facilities. These impacts are not easily observed nor are their social consequences clear. People can be annoyed and have activities interrupted without opposing the flights. Nevertheless, these impacts serve as gauges of the number of people affected by the flights and can provide useful input to airspace planning and mitigation strategies.

Nearly one-third of the field survey respondents reported being highly annoyed by at least one of the following aspects of flights: noise, presence, altitude, or the possibility of a crash. Although most field respondents (67.7%) were not highly annoyed by the flights, about 60% disliked something about them. Noise, altitude, and safety were the predominant concerns raised. Answers to unprompted, open-ended questions indicated that noise was the dominant aspect of flights disliked by the field interview sample; altitude and safety were the next most frequently mentioned items. However, for closed-format questions about annoyance with certain aspects of the flights, a slightly higher percentage of respondents reported high annoyance with the possibility of a crash (20.2%) than with noise (19.2%) or altitude (18.3%). An explanation for these somewhat contradictory results may be that the possibility of crashes generally is not salient, but that when prompted, people do express concern about military aircraft safety. Noise, altitude, and safety also may be interrelated issues.

Approximately one-fifth of the face-to-face interviews indicated sleep disturbance or interruptions in the performance of three or more non-sleep activities had occurred in either the preceding month or a typical month. About 6% of the key informants contacted in affected areas were aware of reported losses in productivity from commercial livestock operations as a result of military low altitude flights. Reported losses were not verified with Air Force claims records. Flight activities were reported to disturb livestock by 4.4% of the face-to-face respondents. Less than 1% of the key informants said they received complaints about disturbance of the very young in group facilities. In the context of households or businesses, effects on the young were reported to be a negative aspect of the flights in nearly 3% of the field interviews. Issues involving adverse health effects and diminished property values almost never were raised in face-to-face interviews when people were asked what they disliked about the flights.

Social characteristics like demographics, attitudes, and beliefs are more strongly related to the impact measures than are flight parameters such as aircraft type, altitude, and noise. Annoyance and reported interrupted activities are most strongly related to age, support for the military, and perceived altitude of flights. Support for low altitude flights, which correlates significantly with annoyance and interrupted activities, also correlates significantly with support for the military, knowledge of the purpose of flights, perceived altitude of flights, population density, age, sex, airspace type, aircraft type, and instantaneous noise levels. Characteristics such as support for the military and some effects of low altitude flights—reports of activities interrupted by the flights and reported annoyance with global characteristics of the flights (noise, presence, altitude, possibility of crashes)—are significantly related to complaints.

Data analyses show that average day-night noise levels (L_{dnmr}) correlate only with awareness of flights. Instantaneous noise levels (SEL) are correlated significantly with support for the flights and with annoyance from noise and altitude, and are correlated marginally with interrupted activities. Perceived number of flights, total scheduled sorties, and airspace type are flight parameters significantly related to complaints.

In summary, the flights cause annoyance and interrupted activities but these impacts do not appear to have much importance in peoples' lives. For the purposes of planning and mitigation, perhaps the most direct strategies are to locate airspaces in areas with low population where there is pre-existing support for the military and to limit the number of flights without compromising operational mission requirements. Additional measures, such as instituting programs that promote information exchange to increase public knowledge about the purpose of the flights and to enhance support for the military, may be appropriate, indirect planning and mitigation strategies.

Noise Impacts

The principal concern in terms of noise impacts is human exposure to noise from aircraft engines and passage of the aircraft through the air.

There is considerable literature on the health effects of noise, but very little of it is directly relevant to the effects of low altitude flying operations (for more detail see Vol. IV, Appendix C). Most studies deal with the effects of sustained noise levels in occupational settings or around airports. The majority of people living beneath a low altitude airspace are unlikely to be exposed to more than one or two noise events per day and these will last only a few seconds. The intensity and duration of the noise associated with low altitude flights is not sufficient to induce physical effects such as hearing loss.

Any non-auditory effects of noise, if they exist, are likely to result from noise as a stressor. The most frequently researched non-auditory health effects associated with noise exposure are adverse reproductive outcomes (ARO) and cardiovascular disease (CVD). Based on the toxicologic and epidemiologic data reported in over 30 studies, there is insufficient evidence to infer a significant risk of birth defects or other AROs associated with levels of noise near major airports and even less so for low altitude flying operations.

CVD is widespread within American society and is thought to result from a host of factors. The potential relationship between noise exposure and CVD was explored in the context of this GEIS. Because available noise studies did not attempt to evaluate CVD but many explored the relationship between noise and hypertension, and because there is some evidence of a relationship between noise and hypertension, hypertension is used in the present study as a surrogate for CVD. The risk estimates conducted to date are based on more or less continuous levels of noise protracted over a long period of time where as exposures in low altitude flying areas are generally intermittent, seasonal, and otherwise very different from occupational conditions. Studies attempting to resolve the relationships between ARO and CVD and noise are complex for a number of reasons. Primarily, they are confounded by a variety of other potential risk factors which are difficult to identify control procedures in epidemiologic studies. As a consequence, conclusions derived from the studies should be tempered with caution in that the degree of accuracy is uncertain. However, the studies do provide reasonable guidance and indicate trends.

On the whole, it can be concluded that noise from subsonic, low altitude flying operations present a negligible threat to humans. Selected locations subjected to unusually high levels of flying activities, however, may incur some incremental health risk as a result of high noise level, though this risk is still relatively low in comparison with many other stressors.

American Indian Impacts

In 1981, there were 106,000 sq. miles of Indian reservations in the United States, with a population of approximately 736,000. About 27,600 sq. miles, or 25% of this area, was under Air Force low altitude airspace. This proportion is slightly less than the approximately 25% of the non-Indian land (906,400 sq. miles) located under low altitude airspace in the United States (including Alaska), or the 30% of the coterminous 48 states. Thus, in the aggregate, Indian lands are not more likely to be overflown than other lands. Although American Indians experience many of the same social impacts as other Americans, low altitude flights may cause additional impacts which are unique to them because of tribal sovereignty, religion, economics, and kinship (for more detail see Vol. IV, Appendix D).

Tribal sovereignty is an important part of Indian culture and of the unique relationship of Indians to the federal government. For many Indians and their leaders, sovereignty helps establish their desired separate identity and special legal status. Consultation with tribal governments in airspace decisions may enhance the legitimacy of tribal leadership in representing tribal interests in those and other decisions, thereby securing the effectiveness of that leadership and leaving the tribe less vulnerable in situations where strong leadership is required. Failure to consult may have an opposite effect.

Indian religious practice is an important part of Indian culture. Low altitude flying activities may impact locations considered to be sacred or interfere with sacred ceremonies. Desecration of sacred locations may result from noise or visual intrusion, which may violate the solitude of prayers and meditation or drive away holy people residing at the sites. Disruptions tc ceremonies may result in having to restart a ceremony at some other time or irrevocably interrupting a once-in-a-lifetime ceremony. The consequences may range from the cost of people's time and the need to reassemble the resources required for the ceremony to negative lifetime spiritual outcomes from the perspective of Indians.

Tribes are attempting to assert a degree of economic self-determination through corporate development of various economic ventures such as agribusiness, fisheries, forestry, and tourism. These ventures could be disrupted periodically by low altitude flying. Subsistence activities also are an important part of traditional culture and are interwoven into the fabric of family economic survival. Disruptions of subsistence activities, such as hunting, gathering, agriculture and herding, from low altitude flying may cause economic hardship or other difficulties.

Older Indians may fear flights because of perceived environmental or other adverse consequences. Because of the very tight kinship structure, coupled with a strong sense that a hurt to one is a hurt to all, the perceptions of the old may have an adverse impact on the family. Since the family is frequently an important element in tribal organization, such adverse impacts to the family may extend to adverse consequences for the tribe and its leadership.

Structures

Concerns have been expressed that low altitude flying operations may cause damage or deterioration to structures. Analytical models, based on experimental studies, were developed for the GEIS to predict structural damage from subsonic low altitude flights. Residences, barns, light industrial buildings, water tanks and wells, and unconventional structures of historic value, such as old adobe buildings and other Early American dwellings of cultural or archaeological sites, are considered along with land slides and avalanches (for more detail see Vol. IV, Appendix E).

Algorithms were developed to predict the likelihood of damage due to acoustic loadings. Specific impacts examined range from hairline cracks (invisible to the naked eye) up to structural cracks and broken windows, water loss for wells and storage containers, and movement of soil or snow. Generally, except for hairline cracks, broken windows, and snow movement, the probabilities are so low as to be essentially non existent. A small probability exists for window cracking to occur in the case of heavy helicopters (>20,000 lb) flying at 50 ft AGL. A similar, low likelihood exists for the passage of bombers flying at 200 ft AGL. It should be noted that FAA regulations do not permit flying closer than 500 ft from structures. Overall, however, the effects from acoustic loads on structures are negligible or low, except under the most unusual circumstances. Under most low altitude flying conditions, vibration impacts from noise exposure are of the same order of magnitude or less than impacts resulting from most natural or human causes, such as design wind loading, building occupancy, and vehicular traffic. Low altitude flights of heavy helicopters can produce substantially higher vibration levels and stress than are normally experienced yet still are expected to be substantially less than the stress induced by design wind loads on buildings.

Wilderness and Parks

In 1981, 23% (6,700 of the 29,000 sq. miles) of designated wilderness lands in the United States were located under Air Force low altitude airspace. This is less than the 25% of the total land area of the entire United States (including Alaska) or the 30% of the coterminous 48 states over which low altitude flights may occur. In the aggregate, wilderness areas are not subjected to more low altitude flying operations than other areas. The dominant portion of the exposed wilderness and parks is located in the western United States.

Although subject to interpretation, the Wilderness Act identifies certain federally protected land as that which retains its primeval character and influence. Presence of aircraft flying at several hundred feet above ground level in wilderness areas may contradict the definition of wilderness as a pristine area unspoiled by the actions of mankind.

Impacts to the use of wilderness and parks assume two principal forms: intrusions which violate a sense of isolation and removal from the influences of industrialized society and intrusions which interfere directly with wilderness and parks recreation activities themselves. Impacts to wilderness and parks use from low altitude flights include impacts associated with solitude, enjoyment of wildlife, safety of users, and implementation of federal trust responsibilities. Solitude involves the opportunity, either as individuals or as small groups, to escape the pressures of modern life by going to a pristine environment. Enjoyment of wildlife includes viewing, photographing, and hunting within this pristine environment. Safety involves the opportunity to enjoy the risks of wilderness and parks without additional risks resulting from the intrusion of modern life. Implementation of federal trust involves the capacity of federal officials to preserve and protect wilderness and parks lands and their use. In comparison with logging, mining, cattle grazing, and recreational motorized vehicle use on other public lands, the impacts of low altitude military flight comprise a relatively benign degradation of wilderness isolation and recreational use. Overall, the effects on the isolation which constitutes much of the wilderness' character are moderate to severe, but is readily mitigated through adequate planning and public involvement (see Vol. IV, Appendix F for more detail).

Wildlife Impacts

Wildlife responses to aircraft range from apparent disregard to panic fleeing and vary with seasons, reproductive status, previous exposure to aircraft, aircraft type, distance from the aircraft, and other factors (for detailed discussions see Vol. IV, Appendix G). Disturbance during the reproductive season is generally the greatest concern because of the potential for reduced reproduction. Wildlife repeatedly exposed to aircraft often appear to become partially accustomed to the flights, and their behavioral responses appear to diminish with time. The intensity of wildlife response is generally greater in open areas and diminishes with greater distance from the aircraft. Helicopters often elicit more intense responses than fixed wing aircraft.

A principal concern is the possibility that low altitude flying operations may add significantly to existing stresses (e.g., habitat loss) on wildlife, thus causing cumulative long-term reductions in wildlife populations. The available literature is not adequate to quantify the impacts of low altitude aircraft on wildlife at the population level, but individual impacts such as reproductive failure can occasionally be expected to occur. Such isolated reproductive failures or relatively few mortalities are generally not a significant concern because wildlife populations usually soon recoup such losses if suitable habitat is available. Thus, cumulative impacts are negligible.

A cumulative effect would occur if there were sustained reproductive failure or behavioral avoidance that resulted in a reduced wildlife population under the airspace. Such an effect would be equivalent to, and cumulative with, reduced population levels caused by habitat loss. No such population reduction due to aircraft has been documented in the literature, but no systematic study to detect such impacts has been conducted. Several studies have reported wildlife avoidance of habitats in areas of frequent helicopter flights and/or landings not involving military airspace. Overall, the literature suggests that Air Force operations in low altitude airspace are not highly disruptive of wildlife reproduction, behavior, or survival. Low altitude flying activity over threatened or endangered species is a substantial concern because of the low population levels of such species.

Livestock and Poultry Impacts

Scientific literature on the effects of aircraft on livestock and poultry is limited, but it shows that impacts sometimes occur when the flights are very close to animals and the disturbance level is very high (for details see Vol. IV, Appendix H). Turkey flocks kept inside sometimes pile up and experience high mortality rates in response to aircraft noise and various disturbances unrelated to aircraft. Pileups with significant mortality in chickens are not reported, and chicken growth, egg laying rate, reproductive function, and hatchability of eggs are not affected adversely by aircraft or simulated aircraft noise.

No adverse effects of subsonic flight are reported for dogs, mink, or pigs. Horses and sheep may react strongly to low altitude aircraft by usually running for a short time, but no injuries or other adverse effects are reported in the literature.

Dairy cows in fields sometimes may react strongly to low altitude aircraft but soon resume normal activities. Cows near airfields show no reduction in milk production compared with cows in areas relatively unaffected by aircraft. Although cattle in fields often appear to be startled by low altitude flights, adverse affects generally are not reported. Cattle in corrals or feedlots sometimes stampede when aircraft fly low overhead, breaking through the fences and injuring themselves.

The potential for economic losses due to aircraft impacts on livestock and poultry is a concern. Instances of substantial regional losses to individual farmers apparently are rare, and it is unlikely that there would be sufficient disturbance to cause regional economic impacts.

Air Quality Impacts

Low altitude flying operations were analyzed with respect to their impacts on (1) air pollutant concentrations as compared with appropriate air quality standards, and (2) visibility in certain national parks and wilderness and parks areas, which were given special protection under the 1977 Clean Air Act Amendments (Vol. IV, Appendix I). The conclusions reached were that (1) air pollutant impacts for all low altitude military airspaces are negligible with respect to National Ambient Air Quality Standards [(NAAQS) see 40 CFR 50] and Prevention of Significant Deterioration (PSD) Class II increments (40 CFR 52); (2) air pollutant impacts from MOA and RA low altitude flight operations are negligible with respect PSD Class I increments; and (3) potential impacts to visibility from low altitude flight operations are negligible for all types of aircraft. It was found that the only remaining air quality concern was with MTRs that passed over PSD Class I areas, which consist primarily of national parks and wilderness areas. Therefore, unless the airspace proposal involves an MTR that passes over a PSD Class I area, the issue of air quality can be addressed very briefly by referencing the above findings. If a proposed MTR intersects a PSD Class I area, an analysis of air quality impacts on the Class I area should be conducted.

Health and Safety Impacts

Health and safety issues related to low altitude flying operations include radio frequency (RF) emission exposure, laser hazards, and aircraft accidents. Each of the nonionizing radar systems used for low altitude flying operations is subject to source strength evaluations prior to deployment in a given aircraft or at a ground support site. These evaluations assess potential exposure situations on the basis of exposure guidance offered by the American National Standards Institute, the major source of guidance provided within the United States. All systems must meet or exceed these guideline values prior to deployment. Similarly, laser systems undergo evaluations which incorporate national and international safety guidance. Systems that are found not to be "eye safe" are restricted to operating only over controlled DOD owned ranges where people are not present. As a consequence of these procedures, exposures to nonionizing radiation and laser systems are expected to result in negligible impacts.

Accident statistics for FYs 1979-88 show that low altitude flying does not cause a disproportionate number of flying mishaps relative to conventional military air operations. Low altitude mishap rates of 1.5 per 100,000 flying hours are at the low range of the Air Force-wide average of 1.5-3 mishaps per 100,000 flying hours. In addition, the relative risk of being injured/killed or experiencing property damage as a result of an aircraft accident or accidental release of ordnance occurring in a low altitude airspace is extremely small.

1. PURPOSE AND NEED FOR THE PROPOSED ACTION

1.1 BACKGROUND: THE NEED FOR LOW ALTITUDE FLYING OPERATIONS

The majority of U.S. Air Force mission objectives include low altitude flying. Depending on the aircraft and mission, the minimum altitude (other than takeoff and landing) may be only a few hundred feet above ground level (AGL) while in designated low altitude airspace. Adversary air defense systems are becoming increasingly sophisticated, accurate, and effective. Most of these threats are supported by various types of radar, optical, or infrared guidance systems enhanced with electronic countermeasures. Sophisticated air defense systems are more readily available on the world market and are proliferating in third world countries as well as in the industrialized nations. Threat environments are more varied today than they have ever been. If U.S. aircrews are to be effective in combat against increasingly capable defenses, they must be able to train with precision at low altitudes to penetrate, find, and attack these systems as well as strategic and tactical targets. Some material transport and delivery missions, as well as peacetime research, development, and testing programs also involve flight at low altitudes. For the purposes of this document, low altitude is defined as 3,000 ft AGL or less.

The Air Force uses, at one time or another, approximately 1,000 designated airspaces in the continental United States (including Alaska) for low altitude training and testing purposes. There are several kinds of low altitude airspace to accommodate the types of mission to be flown. Those airspaces considered in this analysis include military training routes (MTRs); slow speed, low altitude training routes (SRs); military operations areas (MOAs); restricted areas (RAs); and low altitude tactical navigation areas (LATNs). The airspace categories and Air Force operations which occur in these areas are described in Sect. 1.4 and discussed in detail in Appendix A.

Because these flying operations may be intrusive events for areas underneath low altitude airspace, concern has been expressed by some agencies and members of the public about the effects of Air Force low altitude flying operations. Pursuant to the National Environmental Policy Act of 1969 (NEPA), environmental impacts of such flying operations (except LATNs) are analyzed before establishing or modifying a low altitude airspace. The environmental impact assessment process for low altitude flying would benefit from a consolidated, in-depth analysis of issues common to low altitude flying. That determination led to development of this document, the *Generic Environmental Impact Statement for Air Force Low Altitude Flying Operations* (GEIS).

1.2 PURPOSE

The proposed action is to identify common impacts of low altitude flying operations and adopt a NEPA environmental analysis and document preparation process, along with a supporting information base, for future Air Force proposals to establish or modify subsonic, low altitude airspace in the United States. The purpose of the proposed action is to facilitate compliance with NEPA for such airspace proposals. The categories of airspace considered are those noted in Sect. 1.1. This GEIS is the documentation for the proposed action. It is designed to:

1. provide generic analyses of, and conclusions about, the environmental impacts common to Air Force low altitude flying operations and ripe for decision at each level of environmental review;

2. provide a broad forum in which the public and interested state and federal agencies can participate in development of the GEIS;

3. serve as a cost effective reference document for future Air Force NEPA analyses by eliminating repetitive discussions, describing appropriate data, findings, analytical methods, and formatting procedures; and

4. facilitate greater consistency in the Air Force's environmental impact analysis process (EIAP) in future analyses.

The resources of interest in the first objective include airspace use, social, noise, American Indians, structures, wilderness and parks, wildlife, livestock and poultry, air quality, and health and safety. The GEIS constitutes a reference document that examines potential environmental impacts of low altitude flying on these resources which were determined to be ripe for decision and excludes from consideration issues already decided or not yet ripe.

Developing this expanded knowledge of impacts has enabled the public, interested private organizations, and government officials to provide useful information and advice for this impact statement. Public scoping meetings were held around the country and written comments also were solicited (Sect. 1.5). In addition, extensive contacts were made with numerous officials and many affected individuals and interested groups as the impact statement progressed.

Prior to the GEIS, data and environmental impacts for new airspace were determined without benefit of any single, comprehensive report on these issues. As a result many of the same background studies were duplicated in each analysis. The GEIS provides a significant increase in the data, findings, and analytical methods available to the Air Force for developing future NEPA analyses of low altitude airspace proposals.

The availability of the findings developed through this GEIS will improve the level of detail and precision in the EIAP for low altitude airspace proposals. The *EIAP Guide* *for Low Altitude Airspace Proposals* (*EIAP Guide*), Vol. II of the GEIS, provides detailed guidance for using the information and analyses in the GEIS and ensures compliance with Air Force environmental policy and NEPA.

The only alternative considered in this study to the proposed action is the no action alternative. The no action alternative would continue the current process without benefit of the information and findings contained in the GEIS. The current process is one in which each organization preparing NEPA documentation applies the general EIAP (AFR 19-2) to low altitude airspace. The *EIAP Guide* sets forth a detailed process in which the EIAP is tailored specifically to low altitude airspace proposals. This expanded base of knowledge will improve the EIAP and no other reasonable alternative has been identified.

1.3 NEED

To comply with NEPA, the Air Force customarily prepares separate environmental documents to support each low altitude airspace proposal. This requirement of separate documentation will not be changed. This process can be facilitated, however, through the GEIS. Because impacts associated with low altitude flight operations have many similar characteristics throughout the country, an appropriate way to evaluate and document the common issues is to prepare a generic assessment that can be used as a reference document for future NEPA analyses. Whenever a generic environmental impact statement has been prepared (including program or policy statements) and a subsequent statement or environmental assessment is then prepared for an action included within the broader program or policy, the subsequent statement or assessment need only summarize the issues discussed in the broader statement, incorporate discussions by reference, and concentrate on issues specific to the subsequent action. GEIS analyses of environmental impacts are based on current scientific information and will be incorporated by reference in future NEPA documentation prepared for specific low altitude proposed actions. This GEIS is also based on a national scoping process that provides a perspective which could not be duplicated through each site-specific analysis. Environmental planners throughout the Air Force will benefit from more extensive research and data than are available customarily in site-specific assessments and will avoid duplicating generic analyses. Future evaluations of airspace proposals will focus on issues of concern for the specific proposed action while using the generic resource assessments and data provided in this GEIS as supporting documentation.

1.4 LOW ALTITUDE FLYING OPERATIONS

1.4.1 Objectives of Low Altitude Flying Operations

The Air Force conducts flying operations in low altitude airspace to accomplish required operational; training; and research, development, testing, and evaluation missions assigned to individual commanders. Low altitude flights are conducted to achieve and maintain aircrew proficiency in a number of missions, including air defense, air superiority, close air support, strategic and tactical bombing, electronic warfare, strategic and tactical airlift, and tactical reconnaissance.

As noted earlier, low altitude flying is necessary in order for aircraft to avoid detection and destruction by opposing forces. Such training conducted over land is necessary for a number of reasons. This is the environment in which aircraft would normally function in wartime. Some training can be accomplished by simulators; but simulators, though effective in the initial stages of flight training, cannot replicate the full spectrum of complex operational environments aircrews must face. For the foreseeable future, no simulators will provide all the variables of actual maneuvering, ordnance delivery, threat reaction, visual target acquisition, and teamwork with other aircraft. Simulators are especially deficient at visual realism when low altitude, high speed formation tactics are to be practiced. Additionally, simulators cannot generate the gravitational ("G") forces which aircrews experience during tactical maneuvering. Developing the skills required to function effectively in a high "G" realistic combat environment is vital to both aircrew survivability and the USAF mission.

It is also essential that low altitude training occur over land as opposed to water, since the latter would not provide realistic training because of the lack of terrain features. Target acquisition would lack much of the difficult ambiguity which challenges aircrews in land based targets. Furthermore, the absence of terrain features would not allow pilots to learn how to use such features to help avoid detection and destruction. Sustained training over water would also impact aircraft maintenance, component life, and safety. Increased aircraft corrosion would be experienced due to sustained training at low altitudes over salt water. Due to the lack of depth perception over water, aircrews would be exposed to a decreased safety margin at low altitudes. Thus, it is imperative that the Air Force conduct low altitude flights in a realistic environment over actual terrain.

The major commands (MAJCOMs) that utilize low altitude airspace operate a variety of aircraft at various speeds and altitudes in different categories of airspace. Each such MAJCOM has a unique mission and requires different amounts and types of airspaces to meet the goals of training or research, development, test and evaluation programs. Environmental impacts may vary somewhat as a result of these mission-related differences in aircraft and operating procedures. Appendix A examines each command's low altitude flying mission requirements, differences in the types of airspace and aircraft used for low altitude flights by the various commands, and airspace management and utilization procedures.

1.4.2 Airspace Dedicated to Low Altitude Flying Operations

In order to develop and maintain the operational readiness of crews and aircraft, the Air Force as of December 1986 operated, either alone or in conjunction with other branches of the military, almost 1000 low altitude MTRs, SRs, MOAs, and RAs throughout the United States. The GEIS analyzes only airspace below 3,000 ft AGL. Subsonic airspace proposals above 3,000 ft AGL have been determined by the Air Force to have insignificant effect on the environment and are usually categorically excluded from assessment under the Air Force's environmental analyses regulation, AFR 19-2 (Attachment 7). Unique circumstances may dictate, however, that the categorical exclusion would not apply to a particular proposed action. Aeronautical impacts such as safety and usage conflicts are determined by the FAA during informal and formal coordination and approval procedures.

In 1986, the Air Force controlled 599 low altitude MTRs and SRs, 126 low altitude MOAs, and 88 low altitude RAs over the continental United States. The availability of these airspaces for Air Force use varies from one day per month to 24 hours every day. Thus, the entire system is not operating at all times. In a typical month that year, there were approximately 20,000 sorties scheduled in Air Force routes, nearly 48,000 sorties scheduled in Air Force MOAs, and over 53,000 sorties scheduled in Air Force RAs.

The Federal Aviation Administration (FAA) is responsible for approving military airspace, setting conditions for its use, and approving flight operations in Instrument Routes (IRs), MOAs, and RAs. By definition, SRs (involving aircraft speeds less than 250 knots) and LATNs (random flight patterns) do not require FAA approval. Airspace has four dimensions: horizontal and lateral (both parallel to the earth's surface), vertical (distance above the earth's surface), and time (most airspaces not being used for an entire 24-hour day). The FAA approves all four dimensions of MTRs, MOAs, and RAs. In addition, the FAA must now certify that the Air Force has analyzed the environmental impacts of its low altitude MTR, MOA, and RA proposals.

MTRs are airspace corridors established by the Air Force to provide military aircrews with low altitude navigation and tactical training under a variety of conditions (see Fig. 1.4.1). There are two types of MTRs: instrument routes (IRs) that operate under Instrument Flight Rules (IFR) and visual routes (VRs) that operate under Visual Flight Rules (VFR). IRs are developed by the Air Force and approved by the FAA to allow for military aircraft training that cannot be met under the terms of Federal Aviation Regulation (FAR) 91.70 [no aircraft operations in excess of 250 knots (288 miles per hour) below 10,000 ft]. To facilitate training under safe conditions, FAA has granted the Air Force the authority to operate aircraft on IRs in both IFR and VFR conditions below 10,000 ft in excess of 250 knots. VRs are developed by the Air Force and are also contingent on FAA authorization allowing operations under VFR rules below 10,000 ft, in excess of 250 knots for safety of flight.

SRs are similar to MTRs, but aircraft in SRs operate at or below 1,500 ft AGL at speeds of 250 knots or less. Thus, SRs do not require FAA approval as they meet the conditions outlined in FAR 91.70 and are not treated as MTRs. Criteria for the establishment of an SR are determined by the responsible MAJCOM.

MOAs are airspace assignments of defined vertical, horizontal, lateral, and temporal (time) dimensions established outside positive control areas [below 18,000 ft mean sea level (MSL)] to separate certain military aircraft activities from nonparticipating IFR traffic and to identify for VFR traffic where these activities are conducted (see Fig. 1.4.2). MOAs exist only when they are scheduled for military training. The

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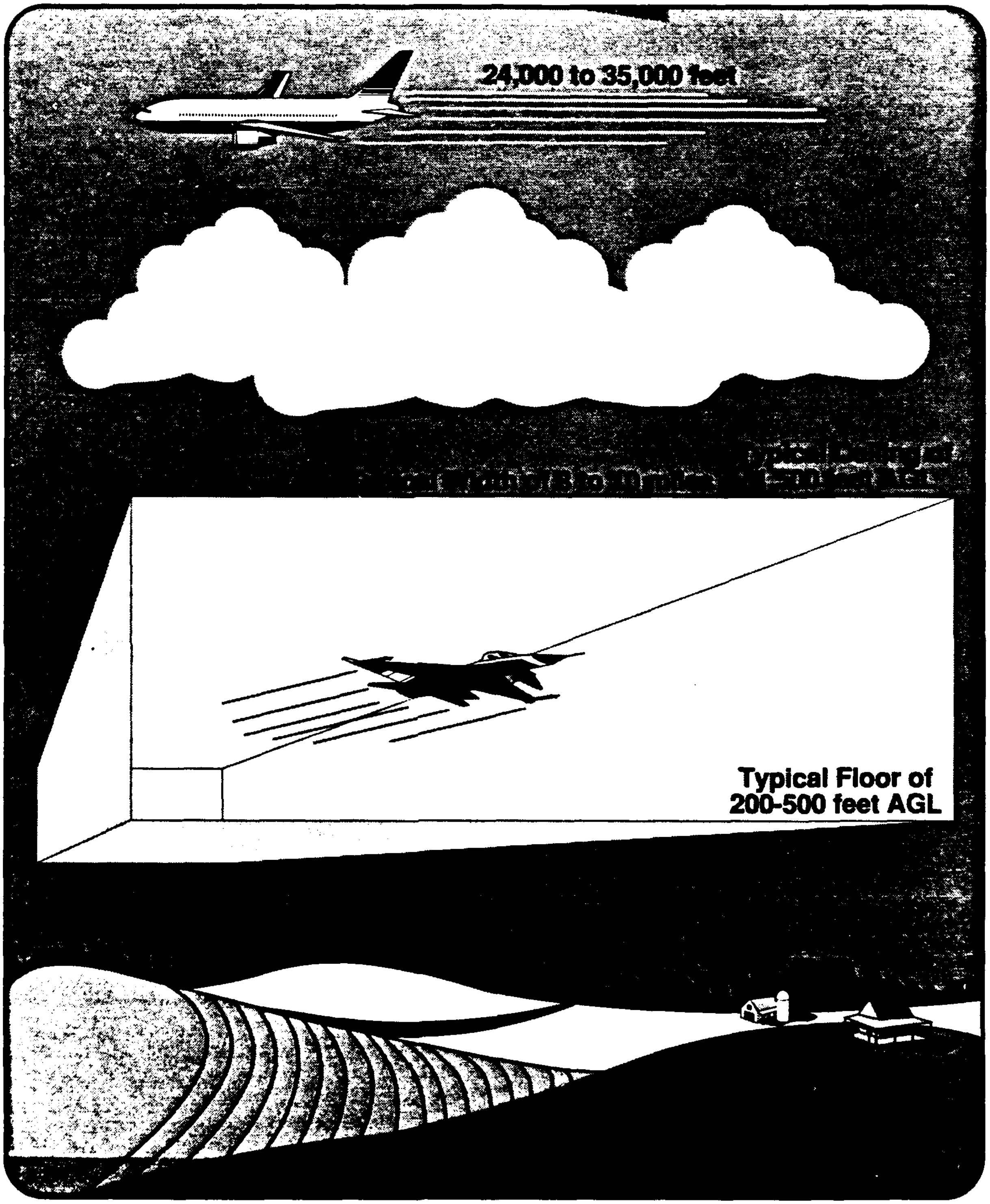

Fig. 1.4.1. Typical Air Force military training route.

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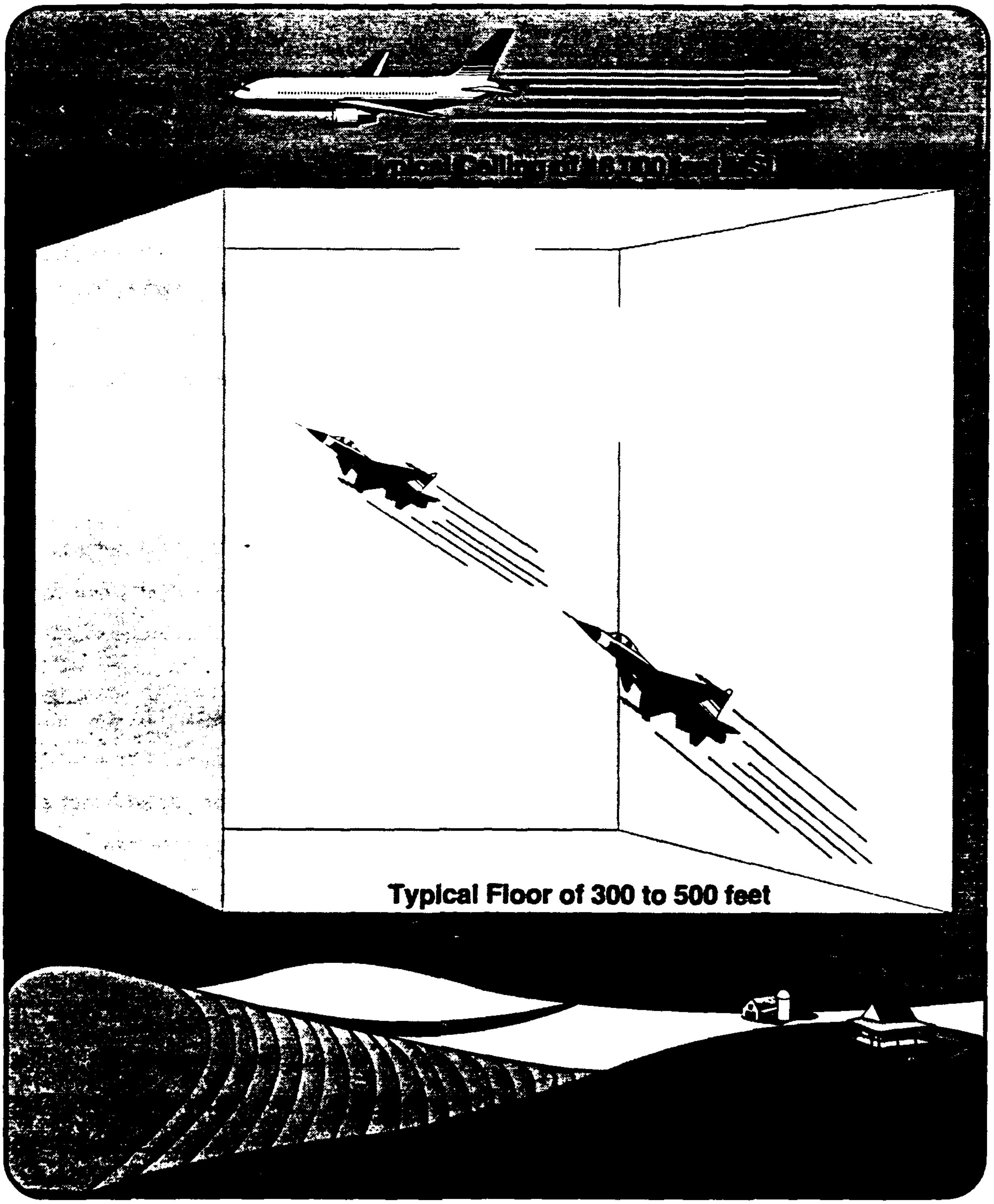

Fig. 1.4.2. Typical Air Force military operations area.

military does have priority in scheduling the airspace within a MOA but must compete with other users. When a MOA is active, nonparticipating aircraft may pass through if operating under VFR or if cleared by the appropriate FAA Flight Service Station. Such use by nonparticipants is permitted because the type of activities conducted in MOAs (air combat maneuvers, air intercepts, low altitude tactical navigation, etc.) are usually considered to be less of a threat to nonparticipating aircraft than the activities conducted in RAs. IFR and VFR traffic can operate in airspace designated as a MOA when it is not being used for military training.

RAs are four-dimensional airspaces in which aircraft flight, while not wholly prohibited, is subject to restriction (see Fig. 1.4.3). No person may operate an aircraft in an RA during designated times unless that person has the advance permission of the controlling or using agency. This restriction is due to the nature of military aircraft training activities conducted in RAs, including bombing and aerial gunnery exercises, which pose hazards to nonparticipating aircraft. For this reason, the military has priority in the scheduling and utilization of RAs. This category of airspace is the only one in which nonmilitary aircraft are excluded from use when the airspace is active. When an RA is not being used for military training, the controlling agency can authorize both IFR and VFR flights for civilian and commercial aircraft.

Low Altitude Tactical Navigation (LATN) Areas are designed to accommodate low altitude training under visual flight conditions at airspeeds of 250 knots indicated air speed (KIAS) or less, at or below 1,500 ft. A LATN area has defined boundaries of sufficient size to permit random selection of navigation points by aircrews conducting LATN training in such a manner that no point is flown over more than once in a 24-hour period. Separation of aircraft operating in LATN areas is provided only by "see and avoid" rules. No restrictions are placed on commercial or general aviation aircraft flying the area.

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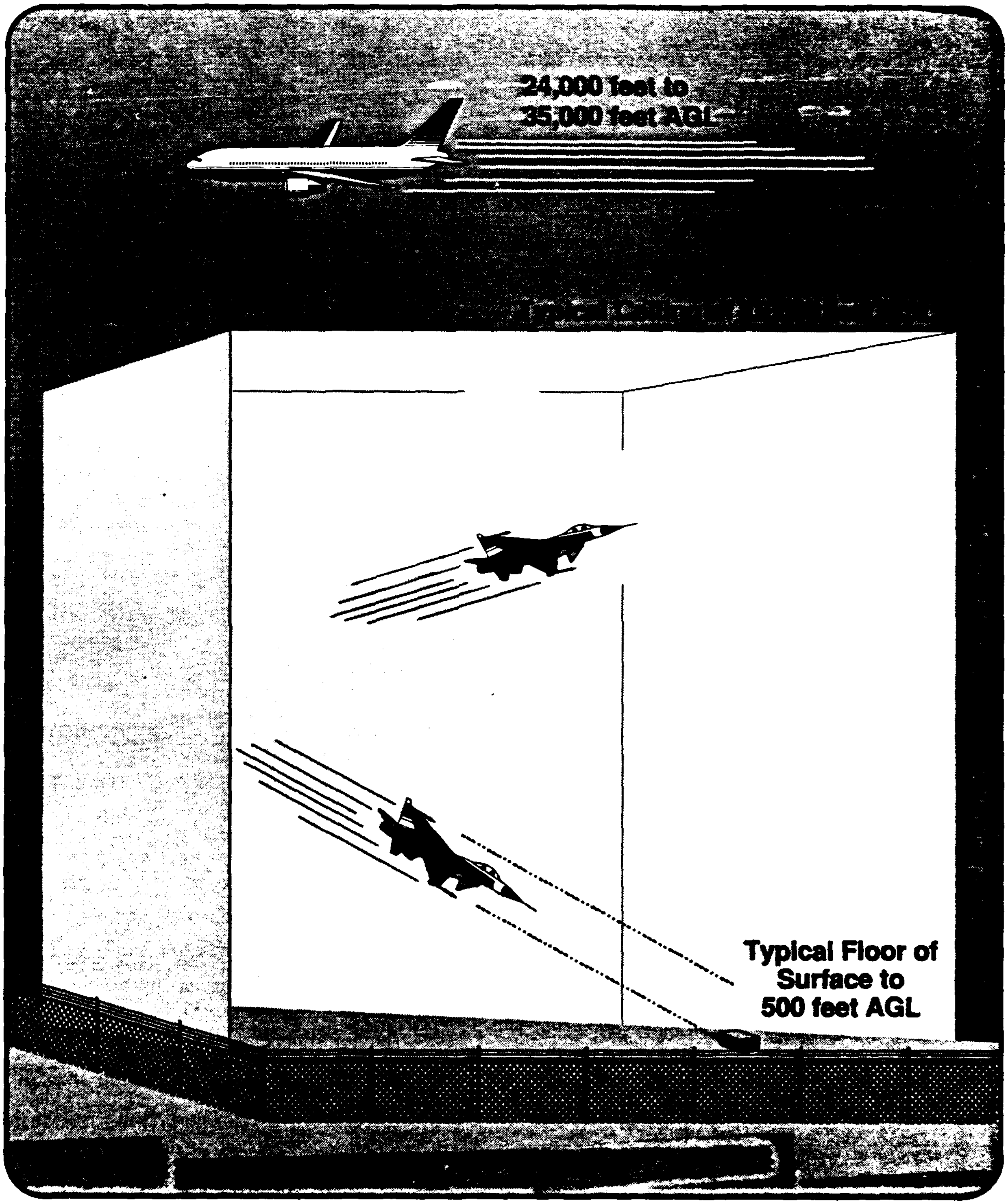


Fig. 1.4.3. Typical Air Force restricted area with associated range.

1.4.3 Aircraft and Operating Parameters for Low Altitude Flying Operations

The Air Force commands that fly in low altitude MTRs, SRs, MOAs, and RAs use a variety of aircraft types at different speeds and altitudes. Each aircraft type has specific operating parameters which enable the commands to carry out their assigned missions. This section provides a brief overview of the Air Force aircraft most commonly operated in low altitude airspace as of 1986. Appendix A describes the various aircraft used by each Air Force command. The aircraft are discussed in terms of their functions as well as the speeds and altitudes at which they are operated in airspace below 3,000 ft AGL.

In 1986, the aircraft most commonly operated in Air Force low altitude airspace was the F-4 Phantom II, a fighter aircraft designed in the 1950s and used extensively in Vietnam (see Table 1.4.1).

Table 1.4.1. Average number of sorties (for most common aircraft types, 1986) scheduled per month in Air Force airspace

Aircraft	MTRs	MOAs	RAs/Ranges	Total
F-4	6,820	9,990	9,724	26,534
F-16	4,004	4,136	13,068	21,208
A-7	4,488	4,400	4,048	12,936
A-10	374	6,776	5,720	12,870

The F-4 has been upgraded continuously over the years and still serves in Air National Guard (ANG), Air Force Reserve (AFRES), and Tactical Air Command (TAC) units. The F-16 Fighting Falcon, designed in part to replace the F-4, was the second most commonly scheduled aircraft in Air Force low altitude airspace in 1986. Currently, the

Air Force (including ANG and AFRES) has more F-16s than any other aircraft (over 1,250) as TAC, ANG, and AFRES units and overseas commands are being equipped with the multirole fighter. The A-7 Corsair, a close air support and interdiction aircraft built between 1968 and 1976, was the third most commonly scheduled aircraft in Air Force low altitude airspace in 1986. Like the F-4, the A-7 has been upgraded over the years and serves primarily in ANG units, though some are still used for TAC training. The fourth most commonly scheduled aircraft in Air Force low altitude airspace in 1986 was the A-10 Thunderbolt II. The A-10 is a close air support aircraft operated by TAC, ANG, AFRES, and Alaska Air Command (AAC) units and Air Force commands overseas.

Planes that fly the most low altitude missions are relatively small, fighter-type aircraft. The Air Force also operates less numerous but much larger planes, such as B-52 and B-1B bombers and C-141 and C-5 transports, in its low altitude airspace.

Although there are exceptions, including some flying operations as low as 100 ft AGL, fighter aircraft generally operate on routes at altitudes of 500 ft AGL, bombers at about 400-500 ft AGL, and transports at about 300-500 ft AGL. Altitudes will vary much more in MOAs and RAs because of the varied training and associated maneuvers conducted in those airspaces. Aircraft speeds also vary depending upon the type of aircraft and operation. This GEIS only addresses the potential environmental impacts associated with subsonic low altitude operations. Aircraft that exceed the speed of sound are permitted to do so only in specifically designated airspace that has been assessed for supersonic operations or at altitudes above 30,000 ft MSL where effects of sonic booms are negligible.

1.5 ISSUES IDENTIFIED THROUGH THE SCOPING PROCESS

1.5.1 Description of the Scoping Process

CEQ regulations define scoping as the "early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to the proposed action" (40 CFR 1501.7). The scoping process for the GEIS was formally initiated by a Notice of Intent published in the *Federal Register* on April 13, 1987 (52 FR 11844). The purpose of the scoping process was to identify significant environmental issues related to low altitude flying operations and to determine the depth of coverage of issues to be addressed. Scoping meetings were conducted during April, May, and June 1987 at 11 locations within the continental United States. These locations were selected to provide good regional coverage throughout the country. The Air Force invited all interested individuals to participate, and approximately 600 written notices of the meetings were mailed to potentially interested organizations.

Table 1.5.1 lists the locations and dates of the public scoping meetings. Meetings with staff from the U.S. Department of the Interior and U.S. Department of Agriculture were held prior to the evening public meetings at Phoenix, Seattle, and Anchorage to discuss those agencies' concerns. The public scoping process also included the submission of 138 written comments from members of the public, interest groups, and governmental agencies. The scoping process continued through preparation of the Draft GEIS with the solicitation of comments from particular public officials at all levels of government, Indian tribes, technical experts in relevant scientific disciplines, and citizens being surveyed as part of the case studies. On October 6, 1987, a meeting was held in Portland, Oregon, with U.S. Department of Interior and U.S. Forest Service staff to discuss their concerns, which were primarily related to potential airspace conflicts. On October 28, 1988, a second meeting was held in Anchorage, Alaska, with U.S.

Department of Interior and U.S. Forest Service staff to discuss wildlife and airspace issues.

Table 1.5.1. GEIS public scoping meetings

Location	1987 date
Boston, Massachusetts	April 28
Raleigh, North Carolina	April 29
Tallahassee, Florida	April 30
Rapid City, South Dakota	May 11
Denver, Colorado	May 12
Kansas City, Kansas	May 13
Dallas, Texas	May 14
Reno, Nevada	May 26
Phoenix, Arizona	May 27
Seattle, Washington	May 28
Anchorage, Alaska	June 9

1.5.2 Environmental Concerns Identified During Formal Scoping

The sections that follow summarize the environmental concerns identified during the formal scoping process. They are organized by GEIS generic resource category and are listed in Table 1.5.2.

1.5.2.1 *Airspace Use and Management*

Airspace use and management issues deal with allocating the horizontal, vertical, lateral, and temporal dimensions of airspace and with managing the competing demands among users for that airspace. These issues, along with closely related safety issues, received

Table 1.5.2. GEIS public scoping comments by generic resource

Generic resource	Concerns/comments
Airspace Use and Management	• airspace is a finite resource • military has too much airspace • should use current airspace more intensively • address cumulative airspace issues of all military
Social	• annoyance • safety of people on ground • intrusion into living and working environment • sleep disturbance • frightening children and adults • interference with communication • interference with peaceful rural settings
Noise	• physiologic reaction • startle reaction • learning disabilities • low birth weight babies • asthma
American Indians	• interference with rural lifestyle and subsistence living • domestic livestock • wildlife • archaeological sites • impact to religious sites and ceremonies • tribal sovereignty • family quality of life
Structures	• damage to fragile historically significant structures • cracking and crumbling of walls and ceilings • cracking of windows • possibility of landslides or avalanches
Wilderness and Parks	• disruption of visitor enjoyment • conflict with wilderness character • interruption of hunting and fishing activities
Wildlife	• interruption of nesting and rearing of young • frightening wildlife away from its habitat • interference with migration • disruption of feeding
Livestock and Poultry	• reduced productivity • interference with breeding • fright responses • interference of military with farmers private flying (e.g., crop dusting, livestock inspection)
Air Quality	• types of emissions • quantities of emissions • effect of emissions on humans or livestock
Health and Safety	• fast and low flying planes are difficult to see and avoid • difficulty in securing information about military operations from traffic controllers • accidents • lasers • non-ionizing radiation

considerable attention throughout the scoping process. Comments were offered by private pilots, commercial flying organizations, and government agencies.

The scoping meetings revealed that the flying community views airspace as a finite resource facing increasing demand from progressively more users. Many people who attended argued that low altitude airspace is in particular demand and that the Air Force needs to shape its airspace requirements and operations to account for the increasing demand.

There is public sentiment that too much airspace is reserved for military use. It was suggested that a smaller number of low altitude airspaces could be used more intensively, thereby freeing some military airspace for civilian use. Many commented that the cumulative airspace impacts of all military low altitude flying operations should be evaluated, rather than just those of the Air Force.

1.5.2.2 *Social*

Numerous concerns were expressed regarding the possible impacts of low altitude flight operations on people, particularly those living in rural areas, and on their lifestyles. Rural areas are the predominant setting for low altitude operations (see Appendix A, Sect. A.3.4). Issues raised included general annoyance, safety, intrusion into people's living and working environments, sleep disturbance, frightening children, interference with human communications, and the incompatibility of low altitude flights with peaceful rural settings and living patterns.

1.5.2.3 *Noise*

A variety of concerns were raised, the most prominent of which were the effects of noise level, startle reaction or surprise on human health. Usually these concerns were expressed as uncertainty about the kinds of health effects that might occur rather than as questions about specific effects. Isolated questions were asked about learning disabilities, low birth weight babies, and asthma.

1.5.2.4 *American Indians*

A number of issues were raised by American Indian tribes, federal agencies, and environmental groups regarding the impacts of low altitude flying operations on American Indians. Many of the concerns were similar to those noted for the general population regarding interference with rural lifestyle, domestic livestock, wildlife, and archaeological sites. A particularly important issue, however, was the potential adverse impact of low altitude flying on American Indian religious sites and ceremonies. Many American Indian activities have religious implications that can be affected adversely by outside interference of any type. Other issues involved effects on tribal economies and subsistence activities such as hunting and fishing, as well as family quality of life. A final issue is tribal sovereignty over airspace above reservations. American Indians generally consider the airspace over their reservations as being subject to their control rather than the federal government's.

1.5.2.5 *Structures*

A limited number of commentors raised issues associated with possible damage to structures from low flying aircraft. The primary concern was possible damage to fragile structures, such as historical sites and adobe buildings, where cracking and crumbling of walls and ceilings were feared. Limited concerns were also expressed about possible cracking of windows and walls in conventional structures. Some inquiries were directed at the possibility that flights might cause landslides or avalanches.

1.5.2.6 *Wilderness and parks*

A number of speakers at the scoping meetings suggested that the presence of Air Force low altitude flying operations over lands designated as wilderness and national parks was incompatible with the values associated with these lands. Concerns focused on disruption of visitor enjoyment and conflict with the wilderness and parks character of the protected areas. Frequent reference was made to an agreement among the National Park Service, U.S. Fish and Wildlife Service, and FAA which recommends that no general and commercial aircraft fly over wilderness areas at altitudes less than 2,000 ft AGL. Federal land management agencies were also concerned that low altitude flight operations might interfere with the wilderness character of study areas and thus jeopardize the final selection of those areas for inclusion in the national wilderness system.

Other concerns associated with recreation included interruption of hunting and fishing activities through disturbance of humans or animals as well as threats to safety from potential aircraft-induced landslides and avalanches or startling of mountain climbers. Concern was also expressed over interference with visitation to various natural and historical sites that are not part of the wilderness system but still possess an ambience that would be disturbed by low flying military aircraft.

1.5.2.7 *Wildlife*

The potential impact of low altitude flight operations on wildlife was a frequent concern of the public and government agencies. Species that are sensitive and require special management received particular attention. These included endangered and threatened species, raptors, waterfowl, and big game animals such as antelope, deer, and big horn sheep. Particular attention focused on interruption of nesting and rearing of young, frightening wildlife from its habitat, interference with migration, and disruption of feeding. The issue of the need to conduct additional research on potential impacts on wildlife arose at several meetings.

1.5.2.8 *Livestock and poultry*

Concern was expressed about the effects of low altitude flights on livestock and poultry, including reduced productivity, interference with breeding success, and fright responses. The latter impact was a particular concern of turkey producers who expressed fear that turkeys might panic and pile up on one another, resulting in suffocation of many birds.

Farmers and ranchers also indicated concern about the interference of military aircraft with their private flying operations involving crop spraying, livestock inspections, access to remote areas, hunting of predators, and general transportation.

1.5.2.9 *Air quality*

Several questions were raised about air quality, but relatively little concern was expressed over it. Typically, questions sought information on the kinds and quantities of emissions from aircraft and whether any are harmful to humans or livestock.

1.5.2.10 *Health and safety*

Non-acoustically related health concerns raised during scoping involved the effects of non-ionizing radiation and laser hazards associated with aircraft. These issues were raised on several occasions and were not prominent.

Safety issues were raised at most of the public and agency scoping meetings. Numerous speakers expressed fear that fast, low flying Air Force planes were difficult to see and avoid. Many civilian pilots felt that it was difficult to get information from FAA air traffic controllers about military low altitude operations, thus increasing the perceived risks they associate with flying through MTRs and MOAs when the Air Force is operating in those airspaces. Although non-Air Force aircraft can operate in these areas under VFR conditions, widespread concern was voiced that pilots worry about the potential for accidents and, consequently, avoid these airspaces.

Concerns also were expressed about interference of low altitude flying on farming and ranching operators, state and federal land management agencies, American Indians, the tourist industry, and recreational users. These competing users believe that Air Force operations impede their flying activities and that they suffer adverse economic impacts as a result. Another concern involved U.S. Forest Service and Bureau of Land Management activities associated with spotting and fighting forest fires. These agencies reported specific examples of military aircraft flying close to fires. The agencies voiced concern that the presence of Air Force low altitude flights in the vicinity of fire fighting operations is a safety problem for their slow moving aircraft.

1.6 SCOPE AND APPROACH

1.6.1 Scope of the Analysis

The proposed action entails data gathering, analyses, and research methods that are somewhat exploratory in nature. Therefore, the concerns that were identified through the scoping process were investigated in almost all cases. Indeed, the majority of comments have arisen frequently in separate scoping processes for specific airspace proposals in various parts of the country. In order to facilitate the impact analysis, the issues were categorized as shown in Table 1.5.2.

Comments on several potential issues are not addressed in the GEIS. Several comments at scoping meetings and in numerous written comments expressed opposition to the Air Force's low altitude flying operations because such operations are an important component of American national security policy, which the commentors opposed. The GEIS does not consider the legitimacy of U.S. policies, nor does it assess the relative merits of devoting national resources to defense or alternative uses. These issues are not within the scope of NEPA or this document. Several issues related to health also were not analyzed. The health effects of jet engine emissions were only indirectly considered by using federal air quality standards as a guide in establishing the degree or significance of various levels of emissions from low altitude flying aircraft. Several other health concerns that were raised in scoping, including learning disabilities, low birth weight babies, and asthma, were not considered because there is no scientific evidence to connect low altitude flying effects and those concerns.

The GEIS analyzes the generic impacts of low altitude flying operations by relying on a case study approach using existing Air Force airspaces to identify the range of impacts that are associated with low altitude flying. Additional studies are also included on specific issues that appeared warranted as a result of concerns raised during the scoping process. The cumulative impacts resulting from multiple low altitude airspaces at a single location are also addressed.

Because future low altitude operations are not expected to be materially different from current operations, identified impacts are expected to be representative of those that will result from future low altitude flying. When new low altitude flying operations or technologies are introduced, those changes will be incorporated in the NEPA documentation for those activities. Thus, this generic analysis provides a broad perspective on the environmental consequences of Air Force low altitude flying operations and details a procedure for evaluating impacts of proposed new or modified airspace allocations for low altitude operations in Vol. II, *EIAP Guide*.

1.6.2 Methodology

1.6.2.1 *Development of data*

As noted in Sect. 1.2, one objective of this GEIS is to develop additional information about the potential impacts of low altitude flying operations for each of the resources categories identified in Table 1.5.2. Obtaining additional information was considered important because the existing information was judged to be of varying quality and applicability to low altitude flying. Three related objectives were identified: (1) accumulate reliable existing information about impacts; (2) develop new supporting information, wherever feasible, to supplement that already available; and (3) develop a system for making this information available for future use in a consistent fashion.

Information was compiled or developed on the following topics, among others: airspace data describing the Air Force's inventory of low altitude airspace and the scheduled flying operations in that airspace, the social impacts data obtained through 721 interviews with people living or working under selected low altitude airspaces and supplemented with over 500 interviews with local officials and newspaper editors in those areas, information obtained from a specifically commissioned national survey on the relative value people put on wilderness and parks areas, an air pollutant dispersion model for low altitude aircraft, a model for estimating structural impacts of low altitude flying operations, and the results of many interviews with knowledgeable federal officials regarding impacts for most of the resources categories.

1.6.2.2 *Case studies*

The case study approach was used as the primary means of gathering information about the range of concerns and impacts of low altitude flying operations. The selection approach is described in Sect. 3.2. Detailed evaluation of the case study airspaces are documented in Vol. III. Findings were incorporated in the generic resource assessments discussed below.

1.6.2.3 *Generic resource assessments*

As discussed in Sect. 1.2, another objective of this GEIS is to compile current knowledge about the nature and magnitude of impacts of low altitude flying operations to each affected resource. This knowledge is documented in Vol. IV, Appendices A through J.

At present, this knowledge base must be reconstituted in part each time the Air Force conducts an analysis for a new low altitude airspace proposal. The GEIS is intended to reduce the inefficiency of that process by compiling existing knowledge in one environmental impact statement, having the information reviewed by the public through the NEPA process, and using the GEIS as a reference document for future Air Force environmental analyses. The knowledge compiled in each generic resource assessment is used in identifying impacts to each resource in the case studies and in the cumulative impact analyses. The knowledge represented by each generic resource assessment and how it is obtained is factored into procedures incorporated in Vol. II, the *EIAP Guide*.

Generic resource assessments and the appropriate appendices in Vol. III include airspace acquisition, management, and utilization (Appendix A); social (Appendix B); noise (Appendix C); American Indians (Appendix D); structures (Appendix E); wilderness and parks (Appendix F); wildlife (Appendix G); livestock and poultry (Appendix H); air quality (Appendix I) and; safety (Appendix J).

The generic resource assessments typically contain six sections. The first section briefly introduces the resource and the kinds of impacts to that resource that have been suggested by past Air Force experience and the scoping process. The second section is a detailed literature review. It examines the existing scientific literature and identifies findings that are considered to be relevant to Air Force low altitude flying operations. Section three details the results of analyses, including case studies, cumulative assessments, and special research tasks, conducted as part of this GEIS. The fourth section highlights the findings from the previous two sections and how those findings relate to Air Force low altitude flying operations. The fifth section describes a system for categorizing the impacts to that resource that will be used in conducting future NEPA analyses for new low altitude airspace proposals. The last section contains a bibliography for the resource that can be used by environmental analysts when additional analysis is required.

1.6.2.4 *Assessment of cumulative impacts*

Council on Environmental Quality regulations (40 CFR 1508.7) require that cumulative impacts be assessed in environmental documents. Cumulative impacts are defined as:

> the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The cumulative or concurrent impacts that occur from low altitude flying operations are those in which operations in two or more airspaces affect the same sensitive resource or "receptor," such as a person, animal, or structure.

2. DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

This chapter describes the Air Force's existing and proposed EIAP procedures for low altitude airspace proposals. As noted in Sect. 1.2, the GEIS' proposed action is to develop an EIAP and supporting base of knowledge that specifically apply to low altitude flying operations. Presently, the Air Force's EIAP involves a general process used for all NEPA analyses. Procedures and findings from the GEIS will result in improved application of the general process as it applies to low altitude airspace actions. The GEIS also documents current knowledge regarding the kinds of environmental impacts expected from aircraft flying at low altitudes.

The existing EIAP constitutes, for GEIS purposes, the no action alternative. If the GEIS proposed action were not established, the Air Force would continue to use this general analytical process for low altitude airspace proposals and would not have the benefit of the information documented in the GEIS. The current EIAP is described in Sect. 2.1. If the proposed action is adopted by the Air Force, the EIAP used in future site specific analyses of low altitude airspace proposals will be one that takes advantage of the GEIS findings and more specifically addresses the relevant issues required for such proposals. A summary of the proposed EIAP guidance is described in Sect. 2.2.1. This proposed EIAP will be supported by the additional findings of environmental impacts associated with low altitude flying that is documented in the GEIS. This information is summarized, by resource, in Sect. 2.2.2.

2.1 CURRENT AIRSPACE DEVELOPMENT AND ENVIRONMENTAL ANALYSIS PROCEDURES

2.1.1 Current Airspace Development Process

The FAA and the Air Force have established procedures for the Air Force to follow in preparing and submitting proposals for low altitude airspace (see Appendix A, Sects. A.3.1 and A.3.2 for more detailed discussions). These procedures pertain to MOAs, RAs, and MTRs (SRs and LATNs do not require formal FAA approval). Although there are some differences in the regulations applicable to the different airspace types, the overall process is similar for each.

FAA Handbook 7400.2, *Procedures for Handling Airspace Matters*, and FAA Handbook 7610.4, *Special Military Operations*, contain FAA policies and rules concerning the development and configuration of MTRs, MOAs, and RAs. Air Force Regulation 55-2, *Airspace Management*, contains the procedures and rules governing airspace proposals and assigns different airspace development and management responsibilities to the various levels of command. AFR 55-34, *Reducing Flight Disturbances*, provides airspace managers with a list of things to avoid in planning airspaces, and AFR 19-2, *Environmental Impact Analysis Process*, outlines the EIAP and its role in airspace development.

Many of the commands also have supplemented existing regulations concerning this airspace development process. With some exceptions, the command regulations are similar to the Air Force-wide regulations found in AFR 55-2. Because of the similarity in regulations, this section examines general Air Force airspace development procedures as outlined in AFR 55-2.

The first steps in the Air Force airspace development process usually occur at the unit level, though the proposal might be initiated by the Numbered Air Force (NAF) or the MAJCOM. The unit airspace manager identifies that unit's training requirements in terms of assigned mission, weapon system capabilities, and beddown (aircraft basing) location. Based upon these requirements, the airspace manager determines the airspace types and configurations necessary to provide suitable training areas. These airspaces must be within a certain distance of the base (depending on the aircraft) and must be of the proper size and configuration to accommodate the type of aircraft training necessary to carry out the unit's mission.

The unit airspace manager then decides whether these training requirements can be met in airspace already set aside for the military or if it is necessary to develop a proposal for new airspace. This decision is made in consultation with the local Air Route Traffic Control Center (ARTCC) responsible for scheduling airspace in the vicinity of the proposed training area. If new airspace or a modification to existing airspace is deemed necessary, the unit airspace manager begins to prepare the preliminary airspace development proposal. In preparing the proposal, the unit airspace manager consults base noise complaint files and aeronautical charts depicting sensitive environmental areas (e.g., population centers and wildlife refuges) and safety risks (e.g., nuclear power plants and towers over 200 ft high). The airspace manager also works with the Base Civil Engineer, environmental planning personnel, and appropriate state and regional agencies in conducting an environmental analysis (see Sect. 2.1.2). The environmental analysis will recommend an alternative resulting in the least impact to the affected resources and propose steps to mitigate those impacts.

After the preliminary airspace development proposal and accompanying environmental analysis are prepared, they are forwarded to the MAJCOM, either through the NAF or directly to the MAJCOM, depending on specific command regulations. In either case, the MAJCOM must eventually approve the airspace proposal and its environmental documentation. Offices responsible for operations, airspace management, environmental planning, and communications at the MAJCOM level work with the Air Force Representative (AF REP) to the appropriate FAA region in reviewing the proposal and environmental analysis. If the proposal and analysis are not acceptable, they are returned to the unit level for revision. The process is repeated with the assistance of the MAJCOM (Office of the Deputy Chief of Staff, Engineering and Services), the AF REP, and the Air Force Directorate of Engineering and Services, Environmental Division (HQ USAF/LEEV), if necessary.

When the final airspace proposal and environmental analysis (for MTRs, MOAs, and RAs only) are approved by the MAJCOM and the appropriate AF REP, they are submitted to the FAA Regional Air Traffic Division (MTRs) or FAA Headquarters (MOAs, RAs). Airspace proposals submitted to FAA Headquarters undergo an extensive aeronautical review to ensure compatibility within the National Airspace System. Formal hearings are often held to determine the extent of potential impacts upon other aviation users. If the FAA approves both the airspace proposal and certifies the environmental documentation, the airspace is established, depicted on aeronautical charts, and available for Air Force use.

2.1.2 Current Environmental Impact Analysis Process

Air Force Regulation 19-2 outlines the procedures and responsibilities involved in the Air Force EIAP to comply with NEPA and CEQ Regulations. Proposals for each type of low altitude airspace must undergo an environmental analysis consistent with AFR 19-2. AFR 19-2, however, applies not only to low altitude airspace proposals but also to all Air Force proposed actions. Some of the Air Force MAJCOMs have developed their own environmental assessment policies and regulations to supplement AFR 19-2, but there is little difference among the commands' environmental assessment processes. Because these differences are slight, this section examines the Air Force-wide EIAP as outlined in AFR 19-2.

The Air Force EIAP usually begins at the unit level when an airspace proposal is initiated. The Environmental Planning Function (EPF) for the unit or, in important proposals, for the MAJCOM has primary responsibility for conducting the EIAP.

Certain actions detailed in AFR 19-2, Attachment 7, dated 10 August 1982, such as subsonic flight above 3,000 ft AGL, are categorically excluded and do not require environmental analysis unless unique circumstances arise. Air Force policy is that the potential environmental impacts, if any, of these activities are usually negligible. For other actions, including subsonic, low altitude airspace proposals, an Environmental Assessment (EA) normally is prepared to help determine if an EIS is necessary. The EA can lead to three possible outcomes: (1) a finding of no significant impact (FONSI), meaning an EIS is not required; (2) a determination that an EIS is required; or (3) a decision to take no further action on the proposal.

If an EA results in a FONSI, the Air Force documents and announces the finding in accordance with CEQ and AF Regulations. The airspace may then be used at any time. However, a public review requiring a 30-day waiting period before using the airspace is necessary under any of the following conditions [AFR 19-2 (11f)]:

- if it is an unusual case, a new kind of action, or a precedent-setting case such as a first intrusion of even a minor development into a pristine area;
- when there is either scientific or environmental controversy over the proposal;
- when it involves a proposal that is similar or closely related to one that usually requires preparation of an EIS (40 CFR 1508.27); or
- if the proposed action would be located in a floodplain or wetland.

If the Air Force determines either initially or as a result of an EA that an EIS is required, the EPF releases a Notice of Intent describing the proposed action. This step leads to the public scoping process which helps determine the scope of issues to be addressed and the significant issues to be analyzed in depth [40 CFR 1500.4(g)]. After the scoping process, the EPF prepares a preliminary draft EIS and submits it to HQ USAF/LEEV for review by HQAFEPC. When the preliminary draft is past the review stage, the draft EIS is filed with EPA for public comment.

The public comment period for the draft EIS is normally 45 days from the publication of the notice of the comment period in the *Federal Register* and culminates in public hearings held in accordance with 40 CFR 1506.6 (c) and (d). The Air Force responds to public comments in the final EIS and files it with the Environmental Protection Agency (EPA). The public is then notified of this filing and, after a 30-day period, the Air Force issues a Record of Decision regarding the proposed action.

2.2 PROPOSED GUIDANCE FOR LOW ALTITUDE AIRSPACE ENVIRONMENTAL ANALYSES

An essential GEIS product is guidance for assessing the environmental impacts of subsonic low altitude airspace. Considerable data gathering and analysis were required to document current knowledge of the impacts of low flying aircraft to sensitive environmental resources. As a result of this effort, specific guidance has been developed for analyzing environmental impacts in future Air Force NEPA documents for low altitude airspace proposals. This process is described in the *EIAP Guide* (Vol. II). This guidance specifically augments the general environmental analysis procedures set forth in the Air Force's existing EIAP as detailed in AFR 19-2.

2.2.1 General Procedures

The following subsections describe the proposed process for conducting future environmental analyses of low altitude airspace proposals. They do not discuss specific methods for analyzing impacts for each potentially affected environmental resource. Such methods are detailed in the *EIAP Guide*. These steps are consistent with the general procedures presently followed under AFR 19-2 for any EIAP. In practice, the Air Force currently follows much of what is proposed in these guidance procedures. In general, the steps include

- developing a complete description of the proposed action and alternatives (DOPAA) by the key Air Force offices involved in the airspace development and EIAP process;
- conducting scoping with all interested government and private organizations and individuals;
- gathering necessary data;
- analyzing data using specific methods that address CEQ criteria (40 CFR 1508.27) regarding significance of impacts;
- documenting assessment results in clear and concise format; and
- reviewing by appropriate Air Force environmental offices.

2.2.1.1 *Developing a complete DOPAA*

Prior to initiating the EIAP for a low altitude airspace proposal, the airspace developer (proponent) submits an AF Form 813, "Request for Environmental Impact Analysis," often called the DOPAA. This form summarizes the proposed action for the environmental planner so that the EIAP can be developed properly. It states the purpose of, and need for, the airspace and contains a description of the proposed action and alternatives. It is extremely important that the DOPAA include adequate information about the dimensions of the airspace and the proposed flying operations. As part of the DOPAA, the proposed airspace is mapped on current 1:500,000-scale sectional charts. In addition, the DOPAA should include a description of realistic alternatives.

The DOPAA must include the following information for the proposed airspace as well as for concurrent airspace that intersects it (the latter being required for cumulative impacts assessment):

- Clear delineation of the horizontal, vertical, lateral, and temporal dimensions of the proposed airspace and alternatives, with the temporal dimension identifying not only the time period in which the airspace will be available to the Air Force but also the average amount of time the airspace will be used in a day. The number of night flights between 10:00 pm and 7:00 am should be noted.

- Specific information on numbers and types of aircraft as well as typical speeds and altitudes at which they will be operating and the length of time each aircraft will be operating at low altitude in a single sortie.

- Details on the flying operations to be conducted in the airspace—specifically, the kinds of operations that will occur and the locations for those operations. For example, will aircraft fly near the centerline of an MTR or will they be distributed more generally throughout the width of the route? Will planes fly alone or in flights of two or more? For MOAs, it is important to detail where various kinds of operations will occur so that the assessment will consider these higher levels of exposure to sensitive resources in those areas of concentration.

To ensure adequate information in the DOPAA and early involvement of appropriate Air Force personnel in the EIAP, the DOPAA is to be written by Air Force personnel responsible for developing and assessing the airspace proposal. These people include representatives from the airspace development office proposing the action, the environmental planning function, public affairs, and the staff judge advocates office. Development of the DOPAA jointly by these key participants facilitates writing of an adequate DOPAA, early identification of potential issues, early coordination of the EIAP among appropriate offices, and effective planning and assigning of responsibilities at the outset of the EIAP.

2.2.1.2 *Conducting scoping*

Scoping is the process by which the Air Force, in conjunction with knowledgeable public and private agencies, organizations, and individuals, identifies the issues that should be addressed in the EIAP. CEQ regulations define the scope of a NEPA document as "the range of actions, alternatives, and impacts to be considered" (40 CFR 1508.25). Although scoping is required only for an EIS by CEQ Regulations, it is Air Force policy to accomplish scoping for low altitude airspace proposals requiring an EA also. Public meetings may be held by the Air Force to facilitate active involvement by private citizens. The scoping process is not defined rigidly in AFR 19-2, but the Air Force encourages public notification for actions of local concern and suggests a number of ways by which this notification may be accomplished, including the use of the news media.

The land area and associated resources affected by low altitude airspace are normally rather large—several thousand square miles or more. Even with reasonably accurate national databases, it is virtually impossible to identify and analyze the potential environmental impacts to all sensitive resources without assistance from local public and private agencies and individuals who possess information that is unpublished and otherwise unavailable to the Air Force. Because of the size of the area being assessed and the difficulty in obtaining information, an open scoping process involving interested organizations and individuals is strongly encouraged if all important issues are to be identified and analyzed.

Scoping begins with a notice of the low altitude airspace proposal being sent by the Air Force proponent to appropriate federal, state, and local officials with responsibility for resources potentially affected by the proposed action. Notification also is sent to environmental, aviation, agriculture, and other groups whose members are likely to be affected by the proposed action. Local news media are to be provided with news releases describing the airspace proposal. This notification also provides the schedule and location for meetings open to the public to solicit suggestions about what issues should be included in the EIAP.

2.2.1.3 *Gathering necessary data*

Completion of airspace EIAPs requires collection of considerable secondary and primary data. The data gathering process begins with what is generally termed secondary information because it is available at the beginning of the process, having been collected from various sources, primarily federal agencies, and compiled as collections of data in documents or computer databases. Much of these secondary data are used in the GEIS and are available to Air Force environmental planners for use in the EIAP. Secondary data include such information as national census figures, health statistics, American Indian tribal membership, county locations of threatened and endangered species, and geographical boundaries of federal lands such as national parks and national refuges. This information is useful for identifying general characteristics of an area and helping focus the analysis on specific impacts, such as a threatened or endangered specie or a wilderness and parks area that may be under the proposed airspace. Secondary databases can also be used for calculating such impacts as the numbers of people affected by proposed low altitude flying operations or the number of square miles of a national park or Indian reservation that will be flown over at low altitude.

Secondary data, however, are insufficient for the level of analysis required in low altitude airspace assessments. Primary, or newly developed, data must be secured from people in the areas affected by proposed airspace actions in order to localize the impact analysis. These data originate in the area of potential impacts and can be gathered through such procedures as interviews with officials and special interests, meetings with local organizations, and through acquisition of local reports and records. Primary data identify such things as the locations of livestock and poultry concentrations, historic structures, raptor nesting areas, and human activities such as schools, hospitals, and subdivisions that could be particularly sensitive to low altitude flying operations. Without this level of site specific information, an analysis will not be focused sufficiently to project impacts and identify acceptable mitigation measures. Because primary data are obtained from the affected areas, effective scoping and data collection should be initiated early in the EIAP.

2.2.1.4 *Analyzing data to address CEQ requirements*

Normally the Air Force documents its analysis of impacts of low altitude airspace with an EA, since these proposed actions are not excluded categorically from NEPA analysis under AFR 19-2, Attachment 7. It is permissible to initiate an EIS at the outset of the NEPA process if the Air Force determines that the likelihood of significant impacts or controversy based on biophysical impacts is great enough to warrant an EIS. Otherwise, an EA must be conducted.

To support a FONSI, an EA should address CEQ "significance" criteria noted below concerning the context and intensity of environmental impacts. If the EA cannot support a FONSI, an EIS must be written, or the proposed action must be dropped or modified. Thus, it is essential that the environmental analysis focus on answering the CEQ significance criteria. Accordingly, EAs should consider the environmental significance of a proposed action in respect to both its context and intensity. In regard to context, the action should be analyzed for its potential long- and short-term impacts on society as a whole, the affected region and interests, and the locality. Essentially, this requirement means that impacts should be interpreted in regard to their importance to society. This requirement can be met by judging the magnitude of the impacts alone or in comparison with other concerns facing society. Intensity or severity of impacts should be evaluated using the following 10 criteria identified in CEQ regulations, 40 CFR Part 1508.27:

1. consideration of both beneficial and adverse impacts,
2. degree to which public health or safety is affected,
3. impacts to unique characteristics of the geographical area,
4. degree to which impacts on human environment are likely to be highly controversial,
5. level of uncertainty of impacts or uniqueness of risks to human environment,
6. precedent-setting nature of the action,
7. contribution to cumulative impacts,
8. impact on areas or objects listed in or eligible for National Register of Historic Places or potential for destruction of important cultural or scientific objects,
9. degree to which endangered or threatened species or habitat may be affected, and
10. whether action may violate an existing environmental law.

To assist in addressing CEQ regulations, the GEIS proposes impact matrices for most resource areas affected by low altitude flying. For site specific analyses, the levels of impact intensity should be considered together with an assessment of context (national, state, or local perspective) in order to make a determination of significance of impact).

The analysis of impacts cannot be completed until an effective scoping process has been implemented and sufficient primary and secondary data have been secured. As with scoping and data collection, the analyses are to be undertaken by an interdisciplinary team of environmental professionals with expertise in the resources that are potentially sensitive to low altitude flying operations. Each of these resources is analyzed in depth in this GEIS. Summaries of the current extent of scientific knowledge are included in Sect. 2.2.2 and in the technical analyses sections of the *EIAP Guide*. These summaries are to be duplicated in EAs to provide basic information about impacts to each resource. The analysis should focus on applying this generic knowledge to the specific airspace proposal with the assistance of the impact matrices.

Many of the impacts of low altitude airspace proposals cannot be quantified precisely. The impact matrices reflect this situation. Exceptions include impacts on air quality and structures where more quantitative data can be developed and analyzed, thereby reducing the level of expert judgement required. With humans and animals, however, the analyses are much more qualitative, and expert judgement is an ever-present requirement. One important point borne out by research is that impacts are not based solely on noise. The fear of accidents, presence, low frequency sound vibrations, and emissions from low flying aircraft also can create impacts.

Another point made clear from research is that perception is a key ingredient in the nature and extent of impacts to most resources. As expected, people react differently to low flying aircraft, as do animals. Some are more noise sensitive than others. Similarly, one group of the population may be more prone toward concern over perceived hazardous activities, such as low flying aircraft and their affect on the human environment, than another group of the population. Cause and effect also pose a particular problem in assessing impacts. Because of the influence of an observer's perceptions, conclusions reached by experts frequently must be identified as based on expert judgement—some of which must unavoidably be based on perceptions. The environmental analysis team must be able to evaluate the validity of arguments put forth in the scoping process. Such judgements should be based on the matrices provided in the technical sections for each environmental resource, but ultimately decisions still will be required based upon the best data and science available.

Once conclusions are reached for each resource based upon the levels of impact specified in the matrices, the findings should be applied to CEQ's significance criteria.

Since determining the levels of impacts specified in the matrices so often is judgmental, there will be occasions when expertise beyond that available on the EIAP team must be brought to the analysis. The draft EA should highlight specifically when such a situation requiring a decision from higher Air Force review authorities exists and submit the draft findings for such a review clearly noting the problematic issue.

A critical part of the analysis process is the comparison of alternatives, which is particularly important because most impacts can be reduced substantially by altering the action. In addition, the judgmental nature of many impacts may make comparison among alternative airspaces more effective in reaching airspace decisions than trying to establish absolute judgments about only a single alternative. Alternatives should be reasonable and include the no action alternative, selecting other airspace in the region, selecting airspace in a different region, modifying the proposed airspace, and any other alternatives that may be reasonably considered. The analysis should explain through standard responses why low altitude flying must be conducted as opposed to use of simulators, flying above 3,000 ft AGL, and flying over water. The consideration of alternatives should demonstrate that the proposed airspace reflects the effort to meet operational objectives minimizing environmental impacts.

CEQ regulations also require treatment of cumulative impacts in which a particular environmental resource is affected by two or more actions. The cumulative impact of interest is that in which two or more low altitude airspaces share, in part, the same airspace. These impacts are termed concurrent. Concurrent impacts are likely to be greater for some resources than the impacts of a single airspace, and the analyses should examine this situation when the DOPAA indicates a proposed airspace will overlap an existing airspace.

2.2.1.5 *Documenting analysis*

Documentation of the EIAP for low altitude airspace should focus on relevant impacts, develop findings that are supported by as much scientific evidence as possible, and be concise and clearly written.

It is important to understand, in developing an EA, that the EA does not require as detailed an analysis as that for an EIS. The purpose of an EA is different; according to CEQ, the EA has three functions "(1) It briefly provides sufficient evidence and analysis for determining whether to prepare an EIS; (2) it aids an agency's compliance with NEPA when no EIS is necessary, i.e., it helps to identify better alternatives and mitigation measures; and (3) it facilitates preparation of an EIS when one is necessary" (*Federal Register*, 46:55, March 23, 1981, 18037).

The CEQ emphasizes that an EA is a "concise document." Such a document "should not contain long descriptions or detailed data which the agency may have gathered. Rather, it should contain a brief discussion of the need for the proposal, the environmental impacts of the proposed action and alternatives, and a list of agencies and persons consulted" (*Federal Register*, 46:55, March 23, 1991, 18037). Although the large land area and resources typically covered by low altitude airspace proposals require more discussion than is feasible in the CEQ's recommended length of 10-15 pages, the CEQ's exception for the complex nature of such proposals should not encourage lengthy airspace EAs. Thus, it is critical that while the EIAP team performs a thorough analysis of environmental impacts, the resulting EA should present the information in a succinct fashion.

There is no specific EA format required by CEQ. However AF policy is to prepare EAs using the same format as that required by CEQ for EISs.

2.2.1.6 *Air Force review of NEPA document*

Although this proposed EIAP for EAs (and EISs) provides more specificity than existed before, airspace EIAP documents require higher review. Appropriate offices may include the staff judge advocate general, base and MAJCOM environmental protection committees, the MAJCOM (if EIAP is conducted at the unit level), HQ USAF/LEEV, and the Deputy Assistant Secretary of the Air Force for Environment, Safety, and Occupational Health (SAF/RQ). While all EISs are required by regulation to be forwarded to AF/LEEV and SAF/RQ, some EAs are required to be forwarded to these offices due to their sensitive nature. It is important that higher authorities not only critique airspace EAs but also bring their expertise to the judgments that often must be made in establishing acceptable levels of impacts for complex and controversial assessments. Problematic issues forwarded to them in the environmental analysis should be decided by specific Air Force officials identified in the EA to ensure consistency with Air Force policy.

2.2.2 GEIS Impact Findings Incorporated in Proposed Guidance

Section 2.2.1 details the procedures for the airspace EIAP. This section contains summaries of the impacts to each generic resource typically affected by low altitude flying. These findings are documented in Appendices A thru J. These summaries are to be incorporated as part of the proposed EIAP guidance for future low altitude airspace assessments. Although they are not impacts of the GEIS proposed action or its alternative, the summaries comprise part of the proposed action and describe the generic impacts expected to occur from the Air Force's future low altitude flying operations. Site-specific analyses should build upon these generic findings.

2.2.2.1 *Airspace Impacts*

Because airspace is considered to be an environmental resource, the FAA evaluates airspace impacts when it approves and establishes an airspace. The FAA and Air Force cooperate in airspace management. Pursuant to the Federal Aviation Act of 1958, the FAA has final authority in use and management of the nation's airspace resource. This includes jurisdiction in approving Air Force proposals for MTRs, MOAs, and RAs and in managing the airspace for competing users once it is established.

In 1986, the Air Force operated in 599 MTRs and SRs, 126 MOAs, and 88 RAs in U.S. low altitude airspace. Combined, these training airspaces covered almost one 1 million sq. miles, or 25% of the country's surface, including Alaska. However, the most heavily utilized airspaces, MOAs and RAs, covered only 4.3% and 0.7% of the continental U.S. (CONUS) land area respectively. Air Force routes and drop zones covered over 818,000 sq. miles, and Air Force MOAs and RAs covered 155,000 and 25,000 sq. miles, respectively.

In recent years, concern has been expressed over the amount of low altitude airspace allocated to military operations. Such airspace is a finite resource with multiple users, including ranchers, farmers, federal and state natural resource agencies, crop dusters, oil and gas companies, general aviation, hunters, and tourists. (The commercial airline industry generally does not require low altitude airspace except near airports where take-off and approach patterns occur at low altitude.) It is general aviation traffic, such as private planes and governmental agency aircraft, that may be affected most because these flights are often conducted below 3,000 ft AGL and under VFR conditions. When unusual civilian flight activity, such as wildlife survey flights or fire detection/fighting flights occur in an area, the agency conducting those flights, if it feels a significant hazard exists, has the responsibility for notifying the appropriate FAA Air

Route Traffic Control Center (ARTCC). The ARTCC or respective FAA Flight Service Station issue notices to airmen (NOTAM) that contain information on the civil/military aviation use in the area. Agencies or individuals desiring scheduling information regarding military low altitude operations in a particular area can secure such information by contacting the nearest FAA Flight Service Station.

Although the amount of airspace designated for military use seems substantial, most of it is not being used for Air Force low altitude flying at any one time. When airspace is not being used by the Air Force, the FAA treats the airspace as if it does not exist. Except for approximately 25,000 sq. miles (0.7% of CONUS land area) of RAs, joint use by commercial and general aviation aircraft under VFR is permitted while the airspace is being used by the Air Force. Military aircraft engaged in low altitude flight operations are under many of the same flight rules as civilian aircraft. The same 500-ft minimum separation, requirement to yield right of way to the aircraft least able to maneuver, and "see and avoid" rules apply to both civilian and military aircraft. Civilian aircraft under IFR will be routed around sectors of military activity when reserved airspace is active. Thus, although the use of low altitude airspace by the Air Force may require civilian use of restrictive flight rules, very little of the airspace is actually denied to civil aviation.

2.2.2.2 *Social Impacts*

Because of the frequency with which the issue of social impacts was raised at public scoping meetings and through other scoping procedures, this issue is among the major concerns of the GEIS (see Vol. IV, Appendix B). Several methods of investigation were used in the analysis of social impacts, most notably a literature review, face-to-face interviews with over 700 people located under case study airspaces, telephone interviews with over 500 key informants (local officials and newspaper editors) in communities under these airspaces, and telephone interviews with airspace schedulers and military public affairs personnel. The principal products of this research are (1) a description of the nature and magnitude of impacts generated by the flights; (2) an understanding of the social characteristics and flight parameters associated with these impacts; and, as a result of this understanding, (3) an indication of what adverse impacts might be mitigated in the airspace planning process, or during or after the implementation of a new or changed airspace.

GEIS research findings indicate that the social impacts of Air Force low altitude flight operations consist of annoyance, disruption of activities, disturbance of the young in group facilities, and economic losses to individuals from livestock disturbance. These impacts may affect both individuals or groups of individuals. Impacts to individuals include annoyance and interrupted activities. For people interviewed face-to-face, the level of impact generally was moderate; nearly one-third of the survey respondents were highly annoyed with one or more aspects of the flights, and almost one-fourth reported being disturbed while sleeping or during three or more non-sleep activities.

Although relatively large numbers of individuals report that they are highly annoyed or that many activities are interrupted, these impacts seldom spur actions other than informal complaints. Therefore, these impacts may not have much importance in the overall scheme of peoples' lives. Evidence that the impacts of low altitude flights may not affect people strongly includes the following: (1) there were very few respondents (4 out of 721) who spontaneously mentioned the flights as something they dislike about their area; (2) nearly 80% of the respondents either supported the low altitude flights (43%) or neither supported nor opposed them (36%); (3) about 61% of the respondents reported liking some aspect of the flights; and (4) only 14 respondents (1.9%) said they had complained about the flights formally. Similarly, flights may affect a large number of people but may not cause community disruption.

Among the actions people can take in response to Air Force low altitude flight operations are registration of complaints (formally and informally), group formation, and other displays of displeasure. Vehement social responses to flights have been reported in such places as Dixie Valley, Nevada, and in Europe. Analyses of data from face-to-face and key informant interviews showed no such highly charged social responses to Air Force training activities in the case study airspaces.

However, lesser responses to the flights did occur in the case study sites. While nearly one-quarter (23%) of those surveyed said that they complained informally to friends or family members, only two percent reported that they had complained formally to authorities about the flights. About one-quarter of the local officials and newspaper editors contacted reported receiving complaints about low altitude flights. Whether these complaints were in response to Air Force activities in case study airspaces or other low altitude airspaces in the vicinity is unclear.

It is important to note that flights may affect people without causing overtly observable responses. As mentioned earlier, low altitude training activities may cause impacts such as annoyance, activity disruption, economic difficulties from livestock disruption, and disruption of young people in group facilities. These impacts are not easily observed nor are their social consequences clear. People can be annoyed and have activities interrupted without opposing the flights. Nevertheless, these impacts serve as gauges of the number of people affected by the flights and can provide useful input to airspace planning and mitigation strategies.

Nearly one-third of the field survey respondents reported being highly annoyed by at least one of the following aspects of flights: noise, presence, altitude, or the possibility of a crash. Although most field respondents (67.7%) were not highly annoyed by the flights, about 60% disliked something about them. Noise, altitude, and safety were the predominant concerns raised. Answers to unprompted, open-ended questions indicated that noise was the dominant aspect of flights disliked by the field interview sample; altitude and safety were the next most frequently mentioned items. However, for closed-format questions about annoyance with certain aspects of the flights, a slightly higher percentage of respondents reported high annoyance with the possibility of a crash (20.2%) than with noise (19.2%) or altitude (18.3%). An explanation for these somewhat contradictory results may be that the possibility of crashes generally is not salient, but that when prompted, people do express concern about military aircraft safety. Noise, altitude, and safety also may be interrelated issues.

Approximately one-fifth of the face-to-face interviews indicated sleep disturbance or interruptions in the performance of three or more non-sleep activities had occurred in either the preceding month or a typical month. About 6% of the key informants contacted in affected areas were aware of reported losses in productivity from commercial livestock operations as a result of military low altitude flights. Reported losses were not verified with Air Force claims records. Flight activities were reported to disturb livestock by 4.4% of the face-to-face respondents. Less than 1% of the key informants said they received complaints about disturbance of the very young in group facilities. In the context of households or businesses, effects on the young were reported to be a negative aspect of the flights in nearly 3% of the field interviews. Issues involving adverse health effects and diminished property values almost never were raised in face-to-face interviews when people were asked what they disliked about the flights.

Social characteristics like demographics, attitudes, and beliefs are more strongly related to the impact measures than are flight parameters such as aircraft type, altitude, and noise. Annoyance and reported interrupted activities are most strongly related to age, support for the military, and perceived altitude of flights. Support for low altitude flights, which correlates significantly with annoyance and interrupted activities, also correlates significantly with support for the military, knowledge of the purpose of flights, perceived altitude of flights, population density, age, sex, airspace type, aircraft type, and instantaneous noise levels. Characteristics such as support for the military and some effects of low altitude flights—reports of activities interrupted by the flights and reported annoyance with global characteristics of the flights (noise, presence, altitude, possibility of crashes)—are significantly related to complaints.

Data analyses show that average day-night noise levels (L_{dnmr}) correlate only with awareness of flights. Instantaneous noise levels (SEL) are correlated significantly with support for the flights and with annoyance from noise and altitude, and are correlated marginally with interrupted activities. Perceived number of flights, total scheduled sorties, and airspace type are flight parameters significantly related to complaints.

In summary, the flights cause annoyance and interrupted activities but these impacts do not appear to have much importance in peoples' lives. For the purposes of planning and mitigation, perhaps the most direct strategies are to locate airspaces in areas with low population where there is pre-existing support for the military and to limit the number of flights without compromising operational mission requirements. Additional measures, such as instituting programs that promote information exchange to increase public knowledge about the purpose of the flights and to enhance support for the military, may be appropriate, indirect planning and mitigation strategies.

2.2.2.3 *Noise Impacts*

The principal concern in terms of noise impacts is human exposure to noise from aircraft engines and passage of the aircraft through the air.

There is considerable literature on the health effects of noise, but very little of it is directly relevant to the effects of low altitude flying operations (for more detail see

Vol. IV, Appendix C). Most studies deal with the effects of sustained noise levels in occupational settings or around airports. The majority of people living beneath a low altitude airspace are unlikely to be exposed to more than one or two noise events per day and these will last only a few seconds. The intensity and duration of the noise associated with low altitude flights is not sufficient to induce physical effects such as hearing loss.

Any non-auditory effects of noise, if they exist, are likely to result from noise as a stressor. The most frequently researched non-auditory health effects associated with noise exposure are adverse reproductive outcomes (ARO) and cardiovascular disease (CVD). Based on the toxicologic and epidemiologic data reported in over 30 studies, there is insufficient evidence to infer a significant risk of birth defects or other AROs associated with levels of noise near major airports and even less so for low altitude flying operations.

CVD is widespread within American society and is thought to result from a host of factors. The potential relationship between noise exposure and CVD was explored in the context of this GEIS. Because available noise studies did not attempt to evaluate CVD but many explored the relationship between noise and hypertension, and because there is some evidence of a relationship between noise and hypertension, hypertension is used in the present study as a surrogate for CVD. The risk estimates conducted to date are based on more or less continuous levels of noise protracted over a long period of time where as exposures in low altitude flying areas are generally intermittent, seasonal, and otherwise very different from occupational conditions. Studies attempting to resolve the relationships between ARO and CVD and noise are complex for a number of reasons. Primarily, they are confounded by a variety of other potential risk factors which are difficult to identify control procedures in epidemiologic studies. As a consequence, conclusions derived from the studies should be tempered with caution in that the degree of accuracy is uncertain. However, the studies do provide reasonable guidance and indicate trends.

On the whole, it can be concluded that noise from subsonic, low altitude flying operations present a negligible threat to humans. Selected locations subjected to unusually high levels of flying activities, however, may incur some incremental health risk as a result of high noise level, though this risk is still relatively low in comparison with many other stressors.

2.2.2.4 *American Indian Impacts*

In 1981, there were 106,000 sq. miles of Indian reservations in the United States, with a population of approximately 736,000. About 27,600 sq. miles, or 25% of this area, was under Air Force low altitude airspace. This proportion is slightly less than the approximately 25% of the non-Indian land (906,400 sq. miles) located under low altitude airspace in the United States (including Alaska), or the 30% of the coterminous 48 states. Thus, in the aggregate, Indian lands are not more likely to be overflown than other lands. Although American Indians experience many of the same social impacts as other Americans, low altitude flights may cause additional impacts which are unique to them because of tribal sovereignty, religion, economics, and kinship (for more detail see Vol. IV, Appendix D).

Tribal sovereignty is an important part of Indian culture and of the unique relationship of Indians to the federal government. For many Indians and their leaders, sovereignty helps establish their desired separate identity and special legal status. Consultation with tribal governments in airspace decisions may enhance the legitimacy of tribal leadership in representing tribal interests in those and other decisions, thereby securing the effectiveness of that leadership and leaving the tribe less vulnerable in situations where strong leadership is required. Failure to consult may have an opposite effect.

Indian religious practice is an important part of Indian culture. Low altitude flying activities may impact locations considered to be sacred or interfere with sacred ceremonies. Desecration of sacred locations may result from noise or visual intrusion, which may violate the solitude of prayers and meditation or drive away holy people residing at the sites. Disruptions to ceremonies may result in having to restart a ceremony at some other time or irrevocably interrupting a once-in-a-lifetime ceremony. The consequences may range from the cost of people's time and the need to reassemble the resources required for the ceremony to negative lifetime spiritual outcomes from the perspective of Indians.

Tribes are attempting to assert a degree of economic self-determination through corporate development of various economic ventures such as agribusiness, fisheries, forestry, and tourism. These ventures could be disrupted periodically by low altitude flying. Subsistence activities also are an important part of traditional culture and are interwoven into the fabric of family economic survival. Disruptions of subsistence activities, such as hunting, gathering, agriculture and herding, from low altitude flying may cause economic hardship or other difficulties.

Older Indians may fear flights because of perceived environmental or other adverse consequences. Because of the very tight kinship structure, coupled with a strong sense that a hurt to one is a hurt to all, the perceptions of the old may have an adverse impact on the family. Since the family is frequently an important element in tribal organization, such adverse impacts to the family may extend to adverse consequences for the tribe and its leadership.

2.2.2.5 *Structures*

Concerns have been expressed that low altitude flying operations may cause damage or deterioration to structures. Analytical models, based on experimental studies, were developed for the GEIS to predict structural damage from subsonic low altitude flights. Residences, barns, light industrial buildings, water tanks and wells, and unconventional structures of historic value, such as old adobe buildings and other Early American dwellings of cultural or archaeological sites, are considered along with land slides and avalanches (for more detail see Vol. IV, Appendix E).

Algorithms were developed to predict the likelihood of damage due to acoustic loadings. Specific impacts examined range from hairline cracks (invisible to the naked eye) up to structural cracks and broken windows, water loss for wells and storage containers, and movement of soil or snow. Generally, except for hairline cracks, broken windows, and snow movement, the probabilities are so low as to be essentially non existent. A small probability exists for window cracking to occur in the case of heavy helicopters (>20,000 lb) flying at 50 ft AGL. A similar, low likelihood exists for the passage of bombers flying at 200 ft AGL. It should be noted that FAA regulations do not permit flying closer than 500 ft from structures. Overall, however, the effects from acoustic loads on structures are negligible or low, except under the most unusual circumstances. Under most low altitude flying conditions, vibration impacts from noise exposure are of the same order of magnitude or less than impacts resulting from most natural or human causes, such as design wind loading, building occupancy, and vehicular traffic. Low altitude flights of heavy helicopters can produce substantially higher vibration levels and stress than are normally experienced yet still are expected to be substantially less than the stress induced by design wind loads on buildings.

2.2.2.6 Wilderness and parks

In 1981, 23% (6,700 of the 29,000 sq. miles) of designated wilderness lands in the United States were located under Air Force low altitude airspace. This is less than the 25% of the total land area of the entire United States (including Alaska) or the 30% of the coterminous 48 states over which low altitude flights may occur. In the aggregate, wilderness areas are not subjected to more low altitude flying operations than other areas. The dominant portion of the exposed wilderness and parks is located in the western United States.

Although subject to interpretation, the Wilderness Act identifies certain federally protected land as that which retains its primeval character and influence. Presence of aircraft flying at several hundred feet above ground level in wilderness areas may contradict the definition of wilderness as a pristine area unspoiled by the actions of mankind.

Impacts to the use of wilderness and parks assume two principal forms: intrusions which violate a sense of isolation and removal from the influences of industrialized society and intrusions which interfere directly with wilderness and parks recreation activities themselves. Impacts to wilderness and parks use from low altitude flights include impacts associated with solitude, enjoyment of wildlife, safety of users, and implementation of federal trust responsibilities. Solitude involves the opportunity, either as individuals or as small groups, to escape the pressures of modern life by going to a pristine environment. Enjoyment of wildlife includes viewing, photographing, and hunting within this pristine environment. Safety involves the opportunity to enjoy the risks of wilderness and parks without additional risks resulting from the intrusion of modern life. Implementation of federal trust involves the capacity of federal officials to preserve and protect wilderness and parks lands and their use. In comparison with logging, mining, cattle grazing, and recreational motorized vehicle use on other public lands, the impacts of low altitude military flight comprise a relatively benign degradation of wilderness isolation and recreational use. Overall, the effects on the isolation which constitutes much of the wilderness' character are moderate to severe, but is readily mitigated through adequate planning and public involvement (see Vol. IV, Appendix F for more detail).

2.2.2.7 *Wildlife impacts*

Wildlife responses to aircraft range from apparent disregard to panic fleeing and vary with seasons, reproductive status, previous exposure to aircraft, aircraft type, distance from the aircraft, and other factors (for detailed discussions see Vol. IV, Appendix G). Disturbance during the reproductive season is generally the greatest concern because of the potential for reduced reproduction. Wildlife repeatedly exposed to aircraft often appear to become partially accustomed to the flights, and their behavioral responses appear to diminish with time. The intensity of wildlife response is generally greater in open areas and diminishes with greater distance from the aircraft. Helicopters often elicit more intense responses than fixed wing aircraft.

A principal concern is the possibility that low altitude flying operations may add significantly to existing stresses (e.g., habitat loss) on wildlife, thus causing cumulative long-term reductions in wildlife populations. The available literature is not adequate to quantify the impacts of low altitude aircraft on wildlife at the population level, but individual impacts such as reproductive failure can occasionally be expected to occur. Such isolated reproductive failures or relatively few mortalities are generally not a significant concern because wildlife populations usually soon recoup such losses if suitable habitat is available. Thus, cumulative impacts are negligible.

A cumulative effect would occur if there were sustained reproductive failure or behavioral avoidance that resulted in a reduced wildlife population under the airspace. Such an effect would be equivalent to, and cumulative with, reduced population levels caused by habitat loss. No such population reduction due to aircraft has been documented in the literature, but no systematic study to detect such impacts has been conducted. Several studies have reported wildlife avoidance of habitats in areas of frequent helicopter flights and/or landings not involving military airspace. Overall, the literature suggests that Air Force operations in low altitude airspace are not highly disruptive of wildlife reproduction, behavior, or survival. Low altitude flying activity over threatened or endangered species is a substantial concern because of the low population levels of such species.

2.2.2.8 *Livestock and poultry impacts*

Scientific literature on the effects of aircraft on livestock and poultry is limited, but it shows that impacts sometimes occur when the flights are very close to animals and the disturbance level is very high (for details see Vol. IV, Appendix H). Turkey flocks kept inside sometimes pile up and experience high mortality rates in response to aircraft noise and various disturbances unrelated to aircraft. Pileups with significant mortality in chickens are not reported, and chicken growth, egg laying rate, reproductive function, and hatchability of eggs are not affected adversely by aircraft or simulated aircraft noise.

No adverse effects of subsonic flight are reported for dogs, mink, or pigs. Horses and sheep may react strongly to low altitude aircraft by usually running for a short time, but no injuries or other adverse effects are reported in the literature.

Dairy cows in fields sometimes may react strongly to low altitude aircraft but soon resume normal activities. Cows near airfields show no reduction in milk production compared with cows in areas relatively unaffected by aircraft. Although cattle in fields often appear to be startled by low altitude flights, adverse affects generally are not reported. Cattle in corrals or feedlots sometimes stampede when aircraft fly low overhead, breaking through the fences and injuring themselves.

The potential for economic losses due to aircraft impacts on livestock and poultry is a concern. Instances of substantial regional losses to individual farmers apparently are rare, and it is unlikely that there would be sufficient disturbance to cause regional economic impacts.

2.2.2.9 *Air quality impacts*

Low altitude flying operations were analyzed with respect to their impacts on (1) air pollutant concentrations as compared with appropriate air quality standards, and (2) visibility in certain national parks and wilderness and parks areas, which were given special protection under the 1977 Clean Air Act Amendments (Vol. IV, Appendix I). The conclusions reached were that (1) air pollutant impacts for all low altitude military airspaces are negligible with respect to National Ambient Air Quality Standards [(NAAQS) see 40 CFR 50] and Prevention of Significant Deterioration (PSD) Class II increments (40 CFR 52); (2) air pollutant impacts from MOA and RA low altitude flight operations are negligible with respect PSD Class I increments; and (3) potential impacts to visibility from low altitude flight operations are negligible for all types of aircraft. It was found that the only remaining air quality concern was with MTRs that passed over PSD Class I areas, which consist primarily of national parks and wilderness areas. Therefore, unless the airspace proposal involves an MTR that passes over a PSD Class I area, the issue of air quality can be addressed very briefly by referencing the above findings. If a proposed MTR intersects a PSD Class I area, an analysis of air quality impacts on the Class I area should be conducted.

2.2.2.10 *Health and safety impacts*

Health and safety issues related to low altitude flying operations include radio frequency (RF) emission exposure, laser hazards, and aircraft accidents. Each of the nonionizing radar systems used for low altitude flying operations is subject to source strength evaluations prior to deployment in a given aircraft or at a ground support site. These evaluations assess potential exposure situations on the basis of exposure guidance offered by the American National Standards Institute, the major source of guidance provided within the United States. All systems must meet or exceed these guideline values prior to deployment. Similarly, laser systems undergo evaluations which incorporate national and international safety guidance. Systems that are found not to be "eye safe" are restricted to operating only over controlled DOD owned ranges where people are not present. As a consequence of these procedures, exposures to nonionizing radiation and laser systems are expected to result in negligible impacts.

Accident statistics for FYs 1979-88 show that low altitude flying does not cause a disproportionate number of flying mishaps relative to conventional military air operations. Low altitude mishap rates of 1.5 per 100,000 flying hours are at the low range of the Air Force-wide average of 1.5-3 mishaps per 100,000 flying hours. In addition, the relative risk of being injured/killed or experiencing property damage as a result of an aircraft accident or accidental release of ordnance occurring in a low altitude airspace is extremely small.

3. DESCRIPTION OF AFFECTED RESOURCES

3.1 RESOURCES TO BE ANALYZED

This chapter describes the environmental resources that may be affected by Air Force low altitude flying operations in the 12 case study airspaces selected for analysis. Chapter 4 discusses the range of impacts that such flying operations have on these resources. Volume III details the affected environment and impacts to the resources for each of the case studies. These resources include airspace, social, noise, American Indian, structures, wilderness and parks, wildlife, livestock and poultry, air quality, and health and safety. Sensitive receptors (e.g., those animate or inanimate objects likely to be adversely affected by low altitude flying) are highlighted in order to focus each resource discussion.

3.2 CASE STUDY APPROACH

The case study approach provides a realistic and convenient means of portraying the environmental impacts occurring under the Air Force's numerous subsonic, low altitude airspaces. Twelve airspaces were selected for analysis through a sampling technique applied to all Air Force airspaces designed to ensure objective selection of a wide variety of low altitude airspaces. This strategy allows a manageable number of cases to be examined and depicts the range of impacts that occur from the great majority of the Air Force's low altitude flying operations.

Three important characteristics of airspaces and associated flight operations went into the case study selection process. First, at least two of each of the five types of airspace under consideration—IRs, VRs, SRs, MOAs, and RAs—were included in the sample assessed. Second, the major Air Force commands engaged in low altitude flying were represented, with the larger commands having more than one airspace assessed. This selection technique served as a way of representing the types of aircraft operated by the Air Force. Lastly, the case studies were selected to ensure a fairly even distribution throughout the continental United States (including Alaska).

The first step in selecting the case study airspaces was to create a randomly ordered list of all IRs, VRs, SRs, MOAs, and RAs, indicating the military command responsible for scheduling the use of each airspace. Starting at the top of the list each airspace was considered in turn. To be selected, an airspace had to contribute to the desired mix of characteristics. As soon as the preferred number of a particular type of airspace were chosen (e.g., IRs, VRs), this type of airspace was no longer considered. Similarly, once the requisite number of military commands was represented, other airspaces controlled by that command were ignored in selecting the remaining case studies. Finally, once a given geographic region of the country was represented, all other airspaces from this same region were disregarded.

The 12 airspaces chosen cover parts of 17 states. Seven of the case studies are located east of the Mississippi River and five are in the west (Table 3.2.1). Figure 3.2.1 shows the location of the airspaces selected.

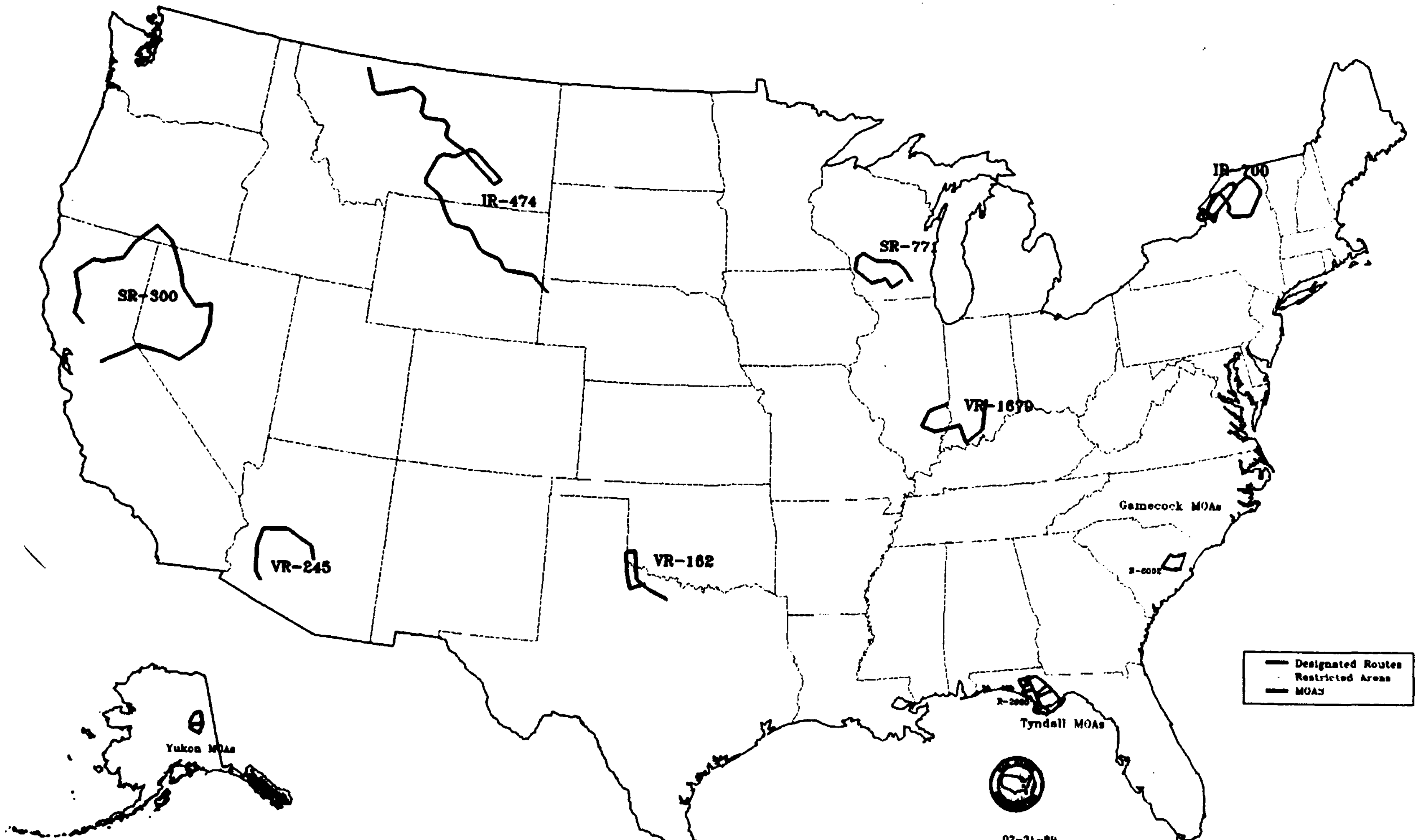
In order to test the representativeness of the airspace selected for the case studies, the average number of sorties and the population densities under the case study airspaces were compared with all low altitude airspace. The results for the case study airspaces compared closely with those for all low altitude airspace.

The case study airspaces were analyzed to identify the nature and magnitude of the environmental impacts on all resources sensitive to the Air Force's low altitude flying

Table 3.2.1. Airspaces selected for case study assessment

Airspace	MAJCOM	Aircraft type	States
IR-700	Strategic Air Command (SAC)	Bombers	New York
IR-474	Strategic Air Command (SAC)	Bombers	Wyoming, Montana, Nebraska
SR-300	Military Airlift Command (MAC)	Transports	California, Nevada, Oregon
SR-771	Air Force Reserve (AFRES)	Transports	Wisconsin
VR-162	Air Training Command (ATC)	Trainers	Oklahoma, Texas
VR-1679	Air National Guard (ANG)	Fighters	Illinois, Indiana, Kentucky
VR-245	Tactical Air Command (TAC)	Fighters	Arizona
Gamecock C MOA	Tactical Air Command (TAC)	Fighters	South Carolina
Tyndall MOA	Tactical Air Command (TAC)	Fighters	Florida
Yukon MOA	Alaskan Air Command (AAC)	Fighters	Alaska
R-6002	Tactical Air Command (TAC)	Fighters	South Carolina
R-2905	Tactical Air Command (TAC)	Drones	Florida

operations. Site visits by environmental professionals representing appropriate disciplines, interviews with knowledgeable public officials and representatives of private groups, and documented information were used. The air quality, structures, and noise



Prepared for the U.S. Air Force by Geographic Data Systems Group.
In Cooperation with Energy Divison, ORNL

Fig. 3.2.1. Low altitude airspace selected for case studies.

analyses relied on models developed for the GEIS to calculate case study impacts. Findings from generic resource assessments (Vol. IV, Appendices A thru J) also were incorporated in the case studies as necessary.

3.3 RESOURCE DESCRIPTIONS

3.3.1 Airspace

Although low altitude airspace is a resource, it is not analyzed in the GEIS in the fashion of other environmental resources. The FAA determines implicitly the acceptability of potential airspace impacts when it approves establishment of the low altitude airspace and manages it according to FAA procedures. Other users of this airspace include farmers and ranchers, natural resource firms, federal and state agencies responsible for managing natural resources, crop dusters, medical helicopters, tourism aircraft, hunters and fisherman, and other general aviation aircraft. Commercial aircraft do not use low altitude airspace except near airports, and low altitude airspace for Air Force operations are established to avoid commercial airports. No quantitative or qualitative mechanism is available that allows the Air Force to categorize the impacts of its operation on competing users for the same airspace. Therefore, the GEIS describes only the airspace used for low altitude flying operations and the Air Force activities in that airspace. For case studies, low altitude airspace includes MTRs, SRs, MOAs, and RAs in which the minimum altitude at some point is under 3,000 ft AGL.

Airspace descriptions for the case studies include the date it was established, the Air Force command scheduling it, the topography under it, and its four dimensions—horizontal and lateral (both parallel to the earth's surface), vertical, and temporal. Such airspace is usually an irregular shape, and its availability to the Air Force may vary from 24 hrs per day, 7 days per week, to much less than that. In turn, the Air Force schedules flying operations to meet specific training requirements. Scheduled airspace use is typically a small fraction of FAA-approved airspace availability. When MTRs, MOAs, and RAs are not being used by the Air Force, they are not "active" and, hence, are not withdrawn from other airspace users. A comprehensive treatment of airspace management issues is given in Appendix A.

3.3.2 Social

People are affected virtually any time that a low altitude airspace is created. They live under low altitude airspace in different population densities, community[1] sizes, cultures, and work environments. Their reactions to low flying aircraft vary considerably based upon many factors that may include demographic characteristics, such as age and sex; living and working environments; activities; attitudes toward the military; sensitivity to noise; and concerns over safety.

In general, however, the distribution of people provides a rough indication of potential social impacts. Locations of cities and towns are important, since they contain higher population densities, and need to be considered in any social impact analysis. Such facilities as schools, hospitals, recreation areas, livestock raising operations, and important cultural sites with high visitation also are sensitive human receptors requiring special attention in any analysis. Social impacts are treated generically in Appendix B.

The humans and communities affected by low altitude flying operations predominantly are located in sparsely populated areas of the country. In compliance with AFR 60-16 and FAR 91.79, Air Force policy requires that pilots flying at low altitude avoid communities by a horizontal distance of at least 1,000 ft. In addition aircraft are required to fly no closer than 500 ft to any person, vehicle, or structure. This can be

[1]Community can refer to a loose aggregation of people as well as to a political or geographic entity.

especially one that lacks agreeable musical quality, is noticeably unpleasant, or any sound that is undesired or interferes with one's hearing of something."

The physical characteristics of sound include its intensity, frequency, and duration. Intensity, or loudness, can range from imperceptibly quiet through noticeable, annoyingly loud, to painful or even harmfully loud. Exposure to very loud sounds for even short durations can cause temporary hearing loss, and longer exposure can permanently impair hearing. Frequency refers to the rate at which vibrations impinge upon the ear. High frequencies can be inaudible to humans (e.g., dog whistles) while extremely low frequencies (below 40 Hz) are more felt than heard if they are strong enough. The human ear is most sensitive to frequencies between 1,000 and 6,000 Hz. Duration refers to how long a sound lasts or is perceived. The sound impulse from an explosion can last less than a second while one is exposed to background sounds all day long.

Sound is measured with instruments that record instantaneous sound levels in decibels (dB). A decibel is "a unit for expressing the relative intensity of sounds on a scale from zero for the average least perceptible sound to about 130 for the average pain level for sound." Because of the wide range of sound intensities heard in a typical day, the ear responds in more of a logarithmic function that a linear one, therefore, a logarithmic scale is used, with the dB being the accepted standard unit for measuring the level of sound. It is generally adjusted to the "A-weighted" scale to better correspond to the normal human response to different frequencies and to compensate for increased human sensitivity to frequencies between 1,000 and 6,000 cycles per second. This adjusted unit is referred to as a "dBA." Table 3.3.1 illustrates human response to typical sound levels measured in dBA.

Slight changes in loudness are difficult to detect. The human auditory system has difficulty registering even a 2-dB change unless two events occur within seconds. Because of limited human sensitivity to the relative changes in sound, when the sound visualized as a 500 ft bubble around an object. This policy, plus a desire to minimize human impacts, leads to airspace siting decisions that avoid more highly populated areas. In fact, the average population density under low altitude airspace, 19 people/sq. miles, is much lower than that of the United States, 76 people/sq. miles (excluding Alaska), or 64 people/sq. miles including Alaska (in 1980). Low altitude airspace covers about 934,000 sq. miles or almost one-third of the lower 48 states, while only about 18 million people or 8% of the U.S. population live under such airspace. In every state except Wyoming, the population density of the portions of the state under low altitude airspace is less than the population density of the state itself. Thus, although all major regions of the United States have at least some low altitude airspace, it is the rural portions of the regions that are affected the most.

3.3.3 Noise

The impacts of noise on humans is traditionally assessed in terms of the annoyance that it causes. This relationship has been explored in the social resource section. There are also auditory and non-auditory health effects from noise. Auditory effects (hearing loss) have been well defined for both temporary and permanent thresholds. Except in highly unusual situations, a receptor under low altitude airspace usually is exposed to noise of insufficient intensity and duration to influence hearing loss. At levels below hearing loss thresholds, the role of noise as a stressor was chosen as an area of study for the GEIS.

The definitions of sound and noise are inextricably bound up in the human perception of each. Sound is defined as "the sensation perceived by the sense of hearing or, mechanical radiant energy that is transmitted by longitudinal pressure waves in a material medium (as air) and is the objective of "hearing." Noise is defined as "a sound,

Table 3.3.1. Typical sound levels measured in the environment and industry

At a given distance from noise source	A-weighted sound level in decibels (dBA)	Noise environments	Subjective impression
	140		
Civil defense siren (100')			
	130		
Jet takeoff (200')	120		Pain threshold
	110	Rock music concert	
Pile driver (50')	100		Very loud
Ambulance siren (100')			
	90	Boiler room	
Freight cars (50')		Printing press plant	
Pneumatic drill (50')	80	In kitchen with garbage disposal	
	70		Moderately loud
Vacuum cleaner (10')	60	Data processing center	
		Department store	
Light traffic (100')	50	Private business office	
Large transformer (200')			
	40		Quiet
Soft whisper (5')	30	Quite bedroom	
	20	Recording studio	
	10		Threshold of hearing
	0		

level is doubled as measured with a sound meter (a 3-dB increase), an individual perceives only a 23-percent increase in sound level. A 10 dB increase in sound level is required to cause an individual to perceive a doubling in sound level. Likewise, sound from two 40 dB sources will result in 43 dB, not 80 dB; four 20 dB sources produce 26 dB, not 80 dBA. Table 3.3.2 illustrates human sensitivity to increases in sound level.

Table 3.3.2. Human perception of increased sound

Sound level increase (dB)	Increase in perceived loudness (%)
3	23
5	41
10	100

Noise is unwanted sound that interferes with normal activities or otherwise diminishes the quality of the environment. It may be intermittent or continuous, steady or impulsive. It may involve a broad range of sound sources and frequencies and be generally nondescript, or it can have a specific, readily identifiable source. There is wide diversity among human responses to noise, which vary not only according to the type and characteristics of the noise source, but also according to the sensitivity, expectations and perceptions of the receptor, the time of day, and the distance between the noise source and the receptor.

The focus of the GEIS health analysis is on annoyance and cardiovascular disease exacerbated by noise. Cardiovascular disease was chosen as the health effect of interest for a variety of reasons. Since cardiovascular disease is caused by many contributing factors it cannot be studied directly. Hypertension, one of the major risk factors associated with cardiovascular disease, is used for measures of potential health impacts for two reasons. First, the traditional method of relying on annoyance as the sole measure of noise impact is inadequate. Although annoyance, measured by social surveys as a function of the day-night average noise level (L_{dn}), has traditionally been used, it does not ensure that actual health effects are assessed adequately. Second, noise is a known stressor, and stress may influence the development of cardiovascular disease and its associated conditions (Appendix C). The health effects analysis projects a general health effect that is based upon noise exposure, measured as an L_{dnmr}. This metric differs from the L_{dn} in that the L_{dnmr} takes a penalty for low flying, high speed aircraft. The data for calculating the exposure include aircraft quantities, types, speeds, altitudes, and times (night or day) of flights.

3.3.4 American Indians

American Indians are considered separately in each case study because many live on reservations and are members of tribes that are accorded special protection under federal law. The great majority of Indian reservations are located west of the Mississippi River in rural areas. As of 1981, there was a total of about 106,000 sq. miles of Indian reservation land in the continental United States supporting approximately 736,000 people. Approximately 27,600 sq. miles, or about 25% of Indian land, was located under Air Force low altitude airspace. This proportion compares favorably with the proportion of non-Indian land under low altitude airspace, which amounts to about 906,400 sq. miles, or approximately 30% of the U.S. excluding Alaska or 25% of the U.S., including Alaska. Use of airspace over the continental United States is segmented in terms of flight scheduling and altitude structure such that only a portion of Indian land area is affected at one time.

Indian culture has certain characteristics, particularly a very close association with the natural environment, that differentiates it from the rest of American society and makes that culture more susceptible to adverse environmental impacts from low altitude flying operations. The major tribal organizations and cultures are described for each case study, and reservations are illustrated on maps of the airspace. The descriptions are designed to focus the case study analyses on aspects of American Indian culture that are considered to be sensitive to low altitude flying. These aspects include tribal sovereignty, religion, economic development and subsistence activities, and the family.

Appendix D discusses more fully American Indian culture and the generic impacts of Air Force low altitude flying operations.

3.3.5 Structures

The structures of interest typically affected by low altitude flying operations are those associated with rural America: one and two story residential and commercial buildings of brick, stone, wood, or sheet metal construction; wooden barns, out buildings, and water towers; occasional larger structures; and natural features such as cliffs and snow in regions that are prone to slides. Each case study provides a general description of the typical structures located under the airspace. This information is based on site visits to the specific area included in the case study, however no inventories of buildings were undertaken. Except in an extreme situation, involving low flying bombers or heavy helicopters over homes with large windows (i.e., 100 ft^2 or greater) or fragile sites of historic and archaeologic significance, a general description is sufficient because of the negligible effect of subsonic aircraft on most structures in comparison with natural forces such as those which result from normal habitation and use, wind and ground vibrations. Impacts are determined by an analytic stress model that is driven by acoustic excitation resulting from aircraft overflights. The analytic model is coupled with a stress vs break/crack probability curve to arrive at a probability model for breaking/cracking as a function of aircraft. Generic structural impacts of low flying aircraft are discussed in Appendix E.

3.3.6 Wilderness and Parks

Federally designated wilderness and parks areas are located predominantly in the western third of the United States. Wilderness areas are defined as:

> A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean ... an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions ...

As of 1981, there were 29,010 sq. miles of protected wilderness lands, of which 6,740 sq. miles, or 23%, were located under Air Force low altitude airspace. This proportion compares favorably with that of non-wilderness areas under such airspace, which total 904,974 sq. miles, or 30% of the nation, excluding Alaska, or 25% of the U.S., including Alaska. Usage of airspace over the continental United States is segmented in terms of flight scheduling and altitude structure such that only a portion of this land area is affected at one time.

Federal and major state protected areas beneath each airspace are identified on a map and discussed in each case study. These areas are deemed by federal and state laws to have special as pristine areas unaffected by modern development and are protected accordingly. Thus, they receive separate treatment in each case study. Wilderness and parks areas are emphasized because they are considered to be particularly sensitive to adverse impacts from low altitude aircraft. These resources and the potential generic impacts of Air Force low altitude flying operations are documented more fully in Appendix F.

3.3.7 Wildlife

Because one-fourth of the U.S. lies under low-level airspace, much of which is over rural areas with abundant wildlife, it is unavoidable that wildlife resources will be exposed substantially to low altitude aircraft. It is beyond the scope of this document to attempt description of the potentially affected wildlife (mammals, birds, reptiles and amphibians) for the entire country. The brief descriptions of these resources for the case studies (Vol. III) convey an idea of their nature and extent. Otherwise, a general picture of the distribution of wildlife resources is given by Table 3.3.7. The table gives figures by state for numbers of endangered and threatened species and acres of various waterfowl and wildlife areas. Detailed explanation of the table appears in Appendix G.

The wildlife resource description for each case study provides a general description of vegetation (as wildlife habitat) and wildlife resources for the area under the airspace. The description focuses on birds and mammals because these are most likely to be affected by low altitude flight. Variability in species occurrence, aircraft and information provided by wildlife officials affects the specificity of information provided for the various case studies. Threatened and endangered species, protected under the federal Endangered Species Act, are of particular concern because of their limited numbers and, frequently, their sensitivity to disturbance. Impacts on a variety of other species, such as game species, raptors, and colony-nesting birds, are also a significant concern because of their sensitivity to low flying aircraft. Appendix G discusses more fully the generic wildlife impacts of Air Force low altitude flying operations.

3.3.8 Livestock and Poultry

As with wildlife, livestock and poultry are exposed substantially to low altitude aircraft operations because both are concentrated in rural areas. Table 3.3.8 indicates the relative occurrence, by state, of important kinds of livestock and poultry, with 1 being the lowest producing state for that livestock or poultry category. The columns are added and the sums are normalized to a scale of 1 to 10, with the highest being the most important livestock and poultry producing state.

Table 3.3.7. State-level counts and areas for endangered and threatened species, state and federal waterfowl areas, and federal wildlife refuges used to derive scores for wildlife quality

State	Total area (acres)	Endangered species I Priority	II Other	(acres) III State	IV Federal	Waterfowl areas V Production	Wildlife (acres) VI Refuge area
AL	32453373	0	2	68732	46332	0	50934
AR	33247799	0	1	183905	132989	0	204942
AZ	72586613	4	9	3195	59762	0	1593080
CA	100067840	8	18	55121	203927	0	293447
CO	66409361	0	0	31571	48923	0	59925
CT	3111977	2	1	7528	178	0	183
DE	1268117	2	1	11485	22065	0	25403
FL	34619451	0	10	1594720	421932	0	473394
GA	37172983	0	2	41000	440820	0	468439
IA	35804790	2	3	136639	66667	214	73694
ID	52911770	0	0	32949	81184	0	85072
IL	35682723	2	3	108824	87934	0	118063
IN	23103850	1	3	45390	7724	0	7724
KS	52348125	0	0	32654	51061	0	51443
KY	25378158	0	1	22956	2040	0	2174
LA	28756757	0	0	393263	23777	0	291221
MA	5008223	2	2	10024	10749	0	12183
MD	6330949	2	3	40638	18759	0	26077
ME	19787768	2	3	19300	24340	1068	31565
MI	36367190	3	3	98939	104617	237	110001
MN	50745444	3	1	440042	182473	171699	444844
MO	44159735	1	4	49144	42964	0	55602
MS	30271727	1	1	13750	58316	0	115584
MT	93174491	3	3	44260	191174	51903	1154556
NC	31234428	0	1	11100	110093	0	256748
ND	44339130	0	0	44838	286248	984307	1273545
NE	48949522	3	3	35872	126705	15376	157097
NH	5777939	2	0	4620	738	0	2229
NJ	4813755	2	1	53500	30352	0	40005
NM	77703066	1	2	9293	95384	0	382167
NV	70327131	0	0	256134	85118	0	2372097
NY	30611736	2	1	46001	20880	0	23522
OH	26227194	1	2	17023	7873	0	8685
OK	44020618	4	6	63420	77357	0	140927
OR	61556811	0	0	46526	241931	0	544546
PA	28779243	2	0	40287	7994	0	9173
RI	671865	2	1	1273	127	0	1244
SC	19345212	1	9	40004	161781	0	189506
SD	48613219	0	0	120815	46102	453222	499495
TN	26450572	0	0	61931	81376	0	84709
TX	167765333	4	14	28152	196923	0	303037
UT	52539390	0	0	76902	94250	0	101855
VA	25462667	2	8	22982	19057	0	104971
VT	5930153	2	0	10225	4794	0	5943
WA	42605476	0	0	254508	86964	0	184609
WI	34858150	3	2	363443	149277	7120	221079
WV	15404214	2	1	2451	0	0	456
WY	62211132	3	3	35824	33645	0	75556

Table 3.3.8. State-level rankings (50=highest and 1=lowest) for various categories of livestock and poultry production

State	Milk cows	Beef cattle	Sheep	Hogs	Mink	Hens	Turkey	Rank sum	Rank (1-10)
AL	16	35	5	32	28	44	48	208	7.27
AK	1	2	2	2	23	4	1	35	1.22
AR	19	36	12	30	26	47	50	220	7.69
AZ	18	19	39	21	22	10	15	144	5.03
CA	49	40	49	23	21	50	42	274	9.58
CO	17	37	46	29	35	22	9	195	6.82
CT	13	5	9	5	20	30	16	98	3.43
DE	3	4	3	15	19	12	43	99	3.46
FL	36	42	10	25	18	43	39	213	7.45
GA	30	32	8	39	36	49	49	243	8.50
HI	4	12	1	13	17	3	24	74	2.59
IA	43	45	41	50	41	39	23	282	9.86
ID	33	28	40	18	46	15	8	188	6.57
IL	37	30	32	49	47	31	13	239	8.36
IN	34	24	25	47	33	46	28	237	8.29
KS	27	43	37	41	27	18	17	210	7.34
KY	40	41	21	37	25	20	25	209	7.31
LA	23	26	14	16	16	21	37	153	5.35
MA	12	6	13	12	32	16	12	103	3.60
MD	29	10	20	22	14	27	45	167	5.84
ME	15	9	19	6	15	33	38	135	4.72
MI	45	13	30	38	43	36	22	227	7.94
MN	47	25	38	48	48	40	30	276	9.65
MO	41	48	31	45	31	34	32	262	9.16
MS	21	33	7	27	13	35	46	182	6.36
MT	7	44	44	24	38	13	11	181	6.33
NC	28	23	16	43	9	45	47	211	7.38
ND	24	38	34	28	8	7	14	153	5.35
NE	26	49	35	46	30	25	21	232	8.11
NH	8	3	11	4	11	11	10	58	2.03
NJ	10	8	17	14	34	14	20	117	4.09
NM	14	27	42	11	10	2	3	109	3.81
NV	6	18	28	7	12	5	2	78	2.73
NY	48	11	22	20	39	38	19	197	6.89
OH	44	20	36	44	40	41	33	258	9.02
OK	25	47	26	26	7	28	35	194	6.78
OR	22	31	43	19	45	23	31	214	7.48
PA	46	14	29	36	44	48	40	257	8.99
RI	2	1	6	1	6	1	7	24	0.84
SC	11	16	4	31	5	37	34	138	4.83
SD	31	46	47	42	37	17	18	238	8.32
TN	39	39	15	35	4	24	36	192	6.71
TX	42	50	50	34	24	42	44	286	10.00
UT	20	21	45	10	49	19	6	170	5.94
VA	32	29	33	33	29	26	41	223	7.80
VT	35	7	18	3	3	8	4	78	2.73
WA	38	22	23	17	42	32	29	203	7.10
WI	50	17	27	40	50	29	26	239	8.36
WV	9	15	24	9	2	9	27	95	3.32
WY	5	34	48	8	1	6	5	107	3.74

Source: USDA 1987.

Each case study includes a general description of livestock and poultry resources (e.g., cattle, sheep, hogs, chickens, turkey, mink) for the area of the airspace. The availability and quality of agricultural statistics information affects the accuracy with which these resources can be quantified and sited geographically with regard to the various case study sites. The important livestock and poultry producing counties under each case study airspace and their relative importance in the state are noted. The potential generic impacts of Air Force low altitude flying activities to livestock and poultry are discussed in greater detail in Appendix H.

3.3.9 Air Quality

The engine exhaust emissions from low altitude flights have the potential to affect air quality. Appendix I includes a full discussion of these impacts. The description of air quality for each case study airspace (see Volume III) identifies portions of the airspaces that cross counties or other areas which have been designated as non-attainment areas with respect to the National Ambient Air Quality Standards (NAAQS) shown in Table 3.3.9. Each NAAQS value in Table 3.3.9 has been established to protect either public health (primary standard), public welfare (secondary standard) or both. Table 3.3.10 also lists Prevention of Significant Deterioration (PSD) increments for mandatory Class I areas (certain national parks and wilderness areas, see Fig. 3.3.9 and Table 3.3.10) and Class II areas (all areas excluding Class I areas and NAAQS non-attainment areas). Appendix I provides more background information concerning the NAAQS and PSD increments. The case studies identify PSD Class I areas which are within 6 miles (10 km) of the boundaries of case study airspaces. These areas are considered to be the sensitive receptors for air quality. The air quality impacts of low altitude flights on PSD Class I areas which are more than 6 miles from an airspace are expected to be negligible and are not considered.

Table 3.3.9. National ambient air quality standards (NAAQS) and prevention of significant deterioration (PSD) increments[a]

Pollutant	Averaging time	NAAQS	PSD increments Class II	PSD increments Class I
Nitrogen dioxide	Annual	100	25	2.5
Sulfur dioxide	3-hr	1,300[b]	512[b]	25[b]
	24-hr	365[b]	91[b]	5[b]
	Annual	80	20	2
Particulate matter	24-hr	150[b,c]	37[b,d]	10[b,d]
	Annual	50[c]	19[d]	5[d]
Carbon monoxide	1-hr	40,000[b]	--	--
	8-hr	10,000[b]	--	--
Ozone	1-hr	235[e]	--	--
Lead	Calendar quarter	1.5	--	--

[a]All concentrations are in units of micrograms/cubic meter.

[b]Not to be exceeded more than once per year.

[c]Particulate matter under 10 microns in diameter (PM-10).

[d]Total suspended particulate matter (TSP). The EPA has issued a notice of proposed rulemaking to replace these with PM-10 increments. The Class II PM-10 24-hr and annual increments would be 30 and 17 $\mu g/m^3$, respectively. The Class I PM-10 24-hr and annual increments would be 8 and 4 $\mu g/m^3$, respectively.

[e]Not to be exceeded on more than one day per year.

Table 3.3.10. Federal Class I areas designated under provision of Clean Air Act Section 162(a)

Area names[1]	State	Acreage	Establishing Public Law	Federal Land Manager
Sipsey Wild.	AL	12,646	93-622	USDA-FS
Bering Sea Wild.	AK	41,113	91-622	USDI-FWS
Mount McKinley NP	AK	1,939,493	64-353	USDI-NPS
Simeonof Wild.	AK	25,141	94-557	USDA-FWS
Tuxedni Wild.	AK	6,402	91-504	USDI-FWS
Chiricahua National Monument Wild.	AZ	9,440	94-567	USDI-NPS
Chiricahua Wild	AZ	18,000	88-577	USDA-FS
Galiuro Wild.	AZ	52,717	88-577	USDA-FS
Grand Canyon NP	AZ	1,176,913	65-277	USDI-NPS
Mazatzal Wild.	AZ	205,137	88-577	USDA-FS
Mount Baldy Wild.	AZ	6,975	91-504	USDA-FS
Petrified Forest NP	AZ	93,493	85-358	USDI-NPS
Pine Mtn. Wild.	AZ	20,061	92-230	USDA-FS
Saguaro Wild.	AZ	71,400	94-567	USDI-NPS
Sierra Ancha Wild.	AZ	20,850	88-577	USDA-FS
Superstition Wild.	AZ	124,117	88-577	USDA-FS
Sycamore Canyon Wild.	AZ	47,757	92-241	USDA-FS
Caney Creek Wild.	AR	14,344	93-622	USDA-FS
Upper Buffalo Wild.	AR	9,912	93-622	USDA-FS
Agua Tibia Wild.	CA	15,934	93-632	USDA-FS
Caribou Wild.	CA	19,080	88-577	USDA-FS
Cucamonga Wild.	CA	9,022	88-577	USDA-FS
Desolation Wild.	CA	63,469	91-82	USDA-FS
Dome Land Wild.	CA	62,206	88-577	USDA-FS
Emigrant Wild.	CA	104,311	93-632	USDA-FS

Table 3.3.10. Continued

Area names[1]	State	Acreage	Establishing Public Law	Federal Land Manager
Hoover Wild.	CA	47,916	88-577	USDA-FS
John Muir Wild.	CA	484,673	88-577	USDA-FS
Joshua Tree Wild.	CA	429,690	94-567	USDI-NPS
Kaiser Wild.	CA	22,500	94-577	USDA-FS
Kings Canyon NP	CA	459,994	76-424	USDI-NPS
Lassen Volcanic NP	CA	105,800	64-184	USDI-NPS
Lava Beds Wild.	CA	28,640	92-493	USDI-NPS
Marble Mtn. Wild.	CA	213,743	88-577	USDA-FS
Minarets Wild.	CA	109,484	88-577	USDA-FS
Mokelumne Wild.	CA	50,400	88-577	USDA-FS
Pinnacles Wild.	CA	12,952	94-567	USDI-NPS
Point Reyes Wild.	CA	25,370	94-544, 94-567	USDI-NPS
Redwood NP	CA	27,792	90-545	USDI-NPS
San Gabriel Wild.	CA	36,137	90-318	USDA-FS
San Gorgonio Wild.	CA	34,644	88-577	USDA-FS
San Jacinto Wild.	CA	20,564	88-577	USDA-FS
San Rafael Wild.	CA	142,722	90-271	USDA-FS
Sequoia NP	CA	386,642	26 Stat. 478 (51st Cong.)	USDI-NPS
South Warner Wild.	CA	68,507	88-577	USDA-FS
Thousand Lakes Wild.	CA	15,695	88-577	USDA-FS
Ventana Wild.	CA	95,152	91-58	USDA-FS
Yolla-Bolly-Middle-Eel Wild.	CA	109,091	88-577	USDA-FS
Yosemite NP	CA	759,172	58-49	USDI-NPS
Black Canyon of the Gunnison Wild.	CO	11,180	94-567	USDI-NPS
Eagles Nest Wild.	CO	133,910	94-352	USDA-FS
Flat Tops Wild.	CO	235,230	94-146	USDA-FS
Great Sand Dunes Wild.	CO	33,450	94-567	USDI-NPS

Table 3.3.10. Continued

Area names[1]	State	Acreage	Establishing Public Law	Federal Land Manager
La Garita Wild.	CO	48,486	88-577	USDA-FS
Maroon Bells-Snowmass Wild.	CO	71,060	88-577	USDA-FS
Mesa Verde NP	CO	51,488	59-353	USDI-NPS
Mt. Zirkel Wild.	CO	72,472	88-577	USDA-FS
Rawah Wild.	CO	26,674	88-577	USDA-FS
Rocky Mountain NP	CO	263,138	63-238	USDI-NPS
Weminuche Wild.	CO	400,907	93-632	USDA-FS
West Elk Wild.	CO	61,412	88-577	USDA-FS
Bradwell Bay Wild.	FL	23,432	93-622	USDA-FS
Chassahowitzka Wild.	FL	23,360	94-557	USDI-FWS
Everglades NP	FL	1,397,429	73-267	USDI-NPS
St. Marks Wild.	FL	17,745	93-632	USDI-FWS
Cohotta Wild.	GA	33,776	93-622	USDA-FS
Okefenokee Wild.	GA	343,850	93-429	USDI-FWS
Wolf Island Wild.	GA	5,126	93-632	USDI-FWS
Haleakala NP	HI	27,208	86-744	USDI-NPS
Hawaii Volcanoes	HI	217,029	64-171	USDI-NPS
Craters of the Moon Wild.	ID	43,243	91-504	USDI-NPS
Hells Canyon Wild.[2]	ID	83,800	94-199	USDA-FS
Sawtooth Wild.	ID	216,383	92-400	USDA-FS
Selway-Bitterroot Wild.[3]	ID	988,770	88-577	USDA-FS
Yellowstone NP[4]	ID	31,488	17 Stat. 32 (42nd Cong.)	USDI-NPS
Mammoth Cave NP	KY	51,303	69-283	USDI-NPS
Breton Wild.	LA	5,000+	93-632	USDI-FWS

Table 3.3.10. Continued

Area names[1]	State	Acreage	Establishing Public Law	Federal Land Manager
Acadia NP	ME	37,503	65-278	USDI-NPS
Moosehorn Wild.	ME	7,501		USDI-FWS
(Edmunds Unit)		(2,782)	91-504	
(Baring Unit)		(4,719)	93-632	
Isle Royale NP	MI	542,428	71-835	USDI-NPS
Seney Wild.	MI	25,150	91-504	USDI-FWS
Boundary Waters Canoe Area Wild.	MN	747,840	88-577	USDA-FS
Voyageurs NP	MN	114,964	99-261	USDI-NPS
Hercules-Glades Wild.	MO	12,315	94-557	USDA-FS
Mingo Wild.	MO	8,000	94-557	USDI-FWS
Anaconda-Pintlar Wild.	MT	157,803	88-577	USDA-FS
Bob Marshall Wild.	MT	950,000	88-577	USDA-FS
Cabinet Mtns. Wild.	MT	94,272	88-577	USDA-FS
Gates of the Mtn Wild.	MT	28,562	88-577	USDA-FS
Glacier NP	MT	1,012,599	61-171	USDI-NPS
Medicine Lake Wild.	MT	11,366	94-557	USDI-FWS
Mission Mtn. Wild.	MT	73,877	93-632	USDA-FS
Red Rock Lakes Wild.	MT	32,350	94-557	USDI-FWS
Scapegoat Wild.	MT	239,295	92-395	USDA-FS
Selway-Bitterroot Wild.[3]	MT	251,930	88-577	USDA-FS
U.L. Bend Wild.	MT	20,890	94-557	USDI-FWS
Yellowstone NP[4]	MT	167,624	17 Stat. 32 (42nd Cong.)	USDI-NPS

Table 3.3.10. Continued

Area names[1]	State	Acreage	Establishing Public Law	Federal Land Manager
Jarbridge Wild.	NV	64,667	88-577	USDA-FS
Great Gulf Wild.	NH	5,552	88-577	USDA-FS
Presidential Range-Dry River Wild.	NH	20,000	93-622	USDA-FS
Brigantine Wild.	NJ	6,603	93-632	USDI-FWS
Bandelier Wild.	NM	23,267	94-567	USDI-NPS
Bosque del Apache Wild.	NM	30,850	93-632	USDI-FWS
Carlsbad Caverns NP	NM	46,435	71-216	USDI-NPS
Gila Wild.	NM	433,690	88-577	USDA-FS
Pecos Wild.	NM	167,416	88-577	USDA-FS
Salt Creek Wild.	NM	8,500	91-504	USDI-FWS
San Pedro Parks Wild.	NM	41,132	88-577	USDA-FS
Wheeler Peak Wild.	NM	6,027	88-577	USDA-FS
White Mtn. Wild.	NM	31,171	88-577	USDA-FS
Great Smoky Mtns. NP[5]	NC	273,551	69-268	USDI-NPS
Joyce Kilmer-Slickrock Wild.[6]	NC	10,201	93-622	USDA-FS
Linville Gorge Wild.	NC	7,575	88-577	USDA-FS
Shining Rock Wild.	NC	13,350	88-577	USDA-FS
Swanguarter Wild.	NC	9,000	94-557	USDI-FWS
Lostwood Wild.	ND	5,557	93-632	USDI-FWS
Theodore Roosevelt NMP	ND	69,675	80-38	USDI-NPS

Table 3.3.10. Continued

Area names[1]	State	Acreage	Establishing Public Law	Federal Land Manager
Wichita Mtns. Wild.	OK	8,900	91-504	USDI-FWS
Crater Lake NP	OR	160,290	57-121	USDI-NPS
Diamond Peak Wild.	OR	36,637	88-577	USDA-FS
Eagle Cap Wild.	OR	293,476	88-577	USDA-FS
Gearhart Mtn. Wild.	OR	18,709	88-577	USDA-FS
Hells Canyon Wild.[2]	OR	108,900	94-199	USDA-FS
Kalmiopsis Wild.	OR	76,900	88-577	USDA-FS
Mtn. Lakes Wild.	OR	23,071	88-577	USDA-FS
Mt. Hood Wild.	OR	14,160	88-577	USDA-FS
Mt. Jefferson Wild.	OR	100,208	90-548	USDA-FS
Mt. Washington Wild.	OR	46,116	88-577	USDA-FS
Strawberry Mtn. Wild.	OR	33,003	88-577	USDA-FS
Three Sisters Wild.	OR	199,902	88-577	USDA-FS
Cape Romain Wild.	SC	28,000	93-632	USDI-FWS
Badlands Wild.	SD	64,250	94-567	USDI-NPS
Wind Cave NP	SD	28,060	57-16	USDI-NPS
Great Smoky Mtns. NP[5]	TN	241,207	69-268	USDI-NPS
Joyce Kilmer-Slickrock Wild.[6]	TN	3,832	93-622	USDA-FS

Table 3.3.10. Continued

Area names[1]	State	Acreage	Establishing Public Law	Federal Land Manager
Big Bend NP	TX	708,118	74-157	USDI-NPS
Guadalupe Mtns. NP	TX	76,292	89-667	USDI-NPS
Arches NP	UT	65,098	92-155	USDI-NPS
Bryce Canyon NP	UT	35,832	68-277	USDI-NPS
Canyonlands NP	UT	337,570	88-590	USDI-NPS
Capitol Reef NP	UT	221,896	92-507	USDI-NPS
Zion NP	UT	142,462	68-83	USDI-NPS
Lyle Brook Wild.	VT	12,430	93-622	USDA-FS
Virgin Islands NP	VI	12,295	84-925	USDI-NPS
James River Face Wild.	VA	8,703	93-622	USDA-FS
Shenandoah NP	VA	190,535	69-268	USDI-NPS
Alpine Lakes Wild.	WA	303,508	94-357	USDA-FS
Glacier Peak Wild.	WA	464,258	88-577	USDA-FS
Goat Rocks Wild.	WA	82,680	88-577	USDA-FS
Mount Adams Wild.	WA	32,356	88-577	USDA-FS
Mount Rainier NP	WA	235,239	30 Stat. 993 (55th Cong.)	USDI-NPS
North Cascades NP	WA	503,277	90-554	USDI-NPS
Olympic NP	WA	892,578	75-778	USDI-NPS
Pasayten Wild.	WA	505,524	90-554	USDA-FS
Dolly Sods Wild.	WV	10,215	93-622	USDA-FS
Otter Creek Wild.	WV	20,000	93-622	USDA-FS
Rainbow Lake Wild.	WI	6,388	93-622	USDA-FS

Table 3.3.10. Continued

Area names[1]	State	Acreage	Establishing Public Law	Federal Land Manager
Bridger Wild.	WY	392,160	88-577	USDA-FS
Fitzpatrick Wild.	WY	191,103	94-567	USDA-FS
Grand Teton NP	WY	305,504	81-787	USDI-NPS
North Absaroka Wild.	WY	351,104	88-577	USDA-FS
Teton Wild.	WY	557,311	88-577	USDA-FS
Washakie Wild.	WY	686,584	92-476	USDA-FS
Yellowstone NP[4]	WY	2,020,625	17 Stat. 32 (42nd Cong.)	USDI-NPS

Area Name	Province	Acreage	Applicable U.S. Public Law
Roosevelt Campobello International Park[7]	New Brunswick Canada	2,721	88-363

[1]Wilderness is abbreviated as Wild., National Park and NP, and National Memorial Park as NMP.

[2]Hells Canyon Wilderness, 193,840 acres overall, of which 108,900 acres are in Oregon and 83,800 acres are in Idaho.

[3]Selway Bitterroot Wilderness, 1,240,618 acres overall, of which 988,770 acres are in Idaho and 25,930 acres are in Montana.

[4]Yellowstone National Park, 2,219,737 acres overall, of which 2,020,625 acres are in Wyoming, 167,624 acres are in Montana, and 31,488 acres are in Idaho.

[5]Great Smoky Mountains National Park, 514,577 acres overall, of which 273,551 acres are in North Carolina, and 241,207 acres are in Tennessee.

[6]Joyce Kilmer-Slickrock Wilderness, 14,033 acres overall, of which 10,201 acres are in North Carolina, and 3,832 acres are in Tennessee.

[7]Section 162(a) designates all international parks as mandatory Class I areas. This designation indicates Congressional intent to prevent visibility impairment from U.S. air pollution sources.

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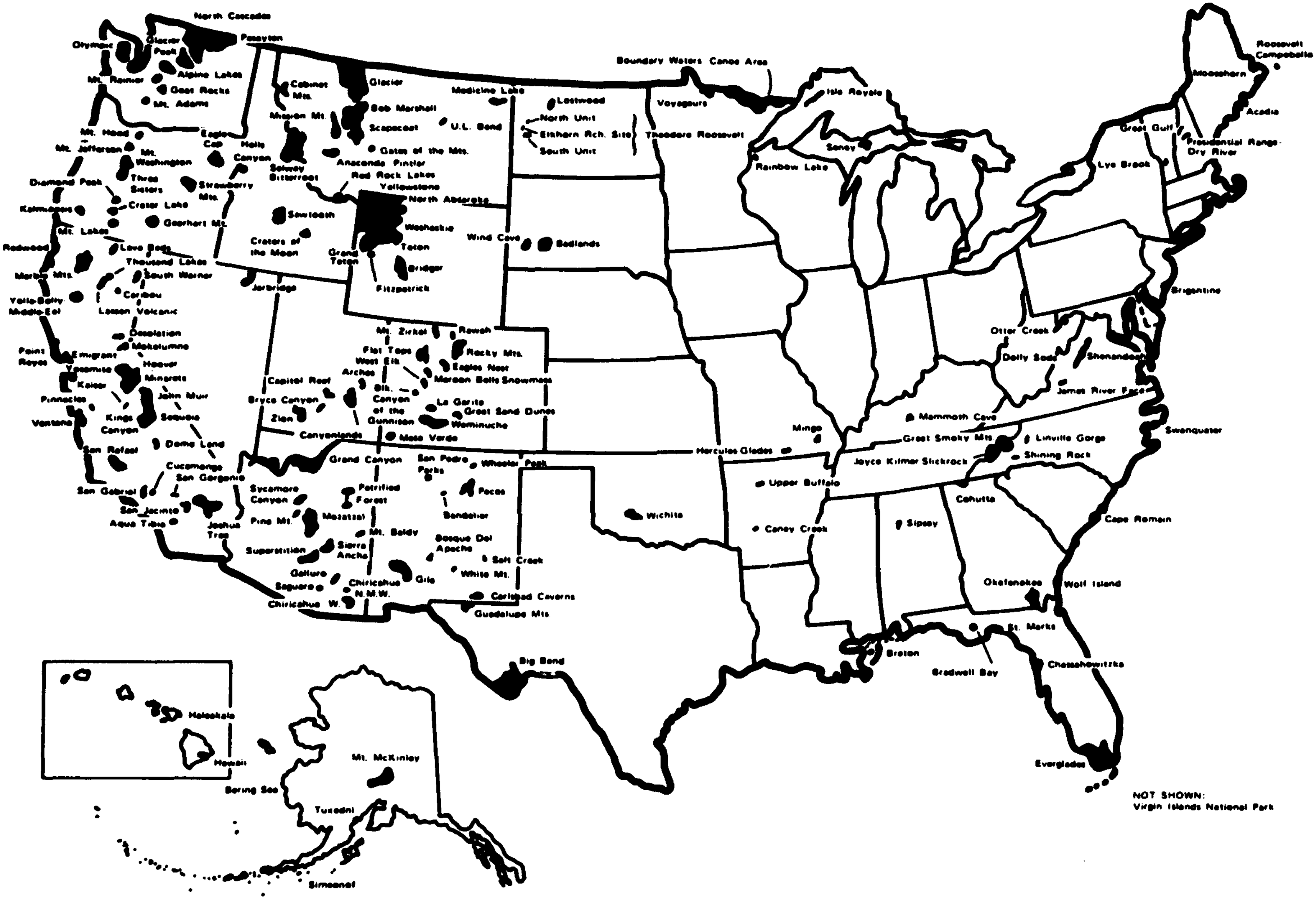

Fig. 3.3.9. PSD Class I air quality areas.

3.3.10 Health and Safety

U.S. aircrews must train under realistic scenarios that simulate enemy defensive systems composed of radar, optical, or infrared guidance systems enhanced with electronic countermeasures. Training to defeat, evade, or suppress these threats includes the use of various defensive measures. In addition to pilot tactics and maneuvering, these include the use of flares and chaff. Flares are used to confuse/deceive threats which seek on infrared heat sources, and chaff is used to confuse/deceive threats which use radar systems. Low altitude military operations that involve the use of this specialized training are conducted in restricted airspace over air to ground ranges owned by DOD or in MTRs and MOAs that have been environmentally assessed for such specific purposes.

With respect to aircraft accidents during low altitude flying, no data or analysis is appropriate to describe the aircraft accident potential due to mechanical failures or pilot error for a particular geographic region or location. Accident rates are more dependent on aircraft operations than location of flight. For that reason, it was determined that a generic analysis of all Air Force low altitude flight operations occurring during the past 10 fiscal years would be appropriate. Appendix J of Volume IV describes the information, analysis, and results of the low altitude flight safety investigation.

Aircraft accident potential as a result of bird strikes is a continuing concern particularly for low altitude flying operations. The Air Force implemented a Bird Aircraft Strike Hazard (BASH) program to develop information on bird populations and movements so that bird strike potential can be reduced. The BASH team can predict bird strike frequencies for any geographic location within the CONUS and indicate critical migratory periods. Figure 3.3.10 shows migratory flight patterns for the U.S.

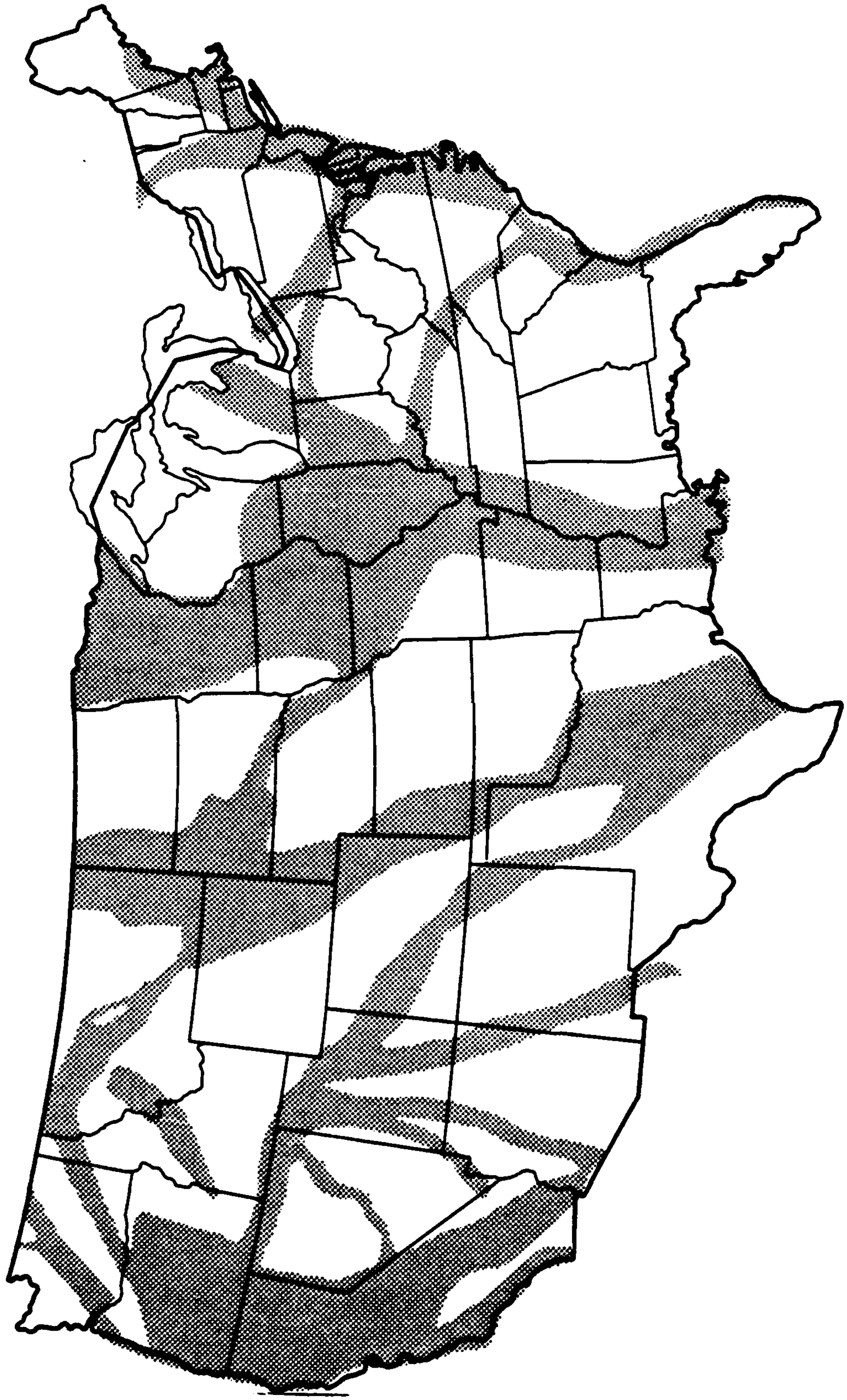

Fig. 3.3.10. Migratory flight patterns for the U.S.

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4. ASSESSMENT OF ENVIRONMENTAL IMPACTS

The previous chapter described the ten resources (viz., airspace, social, noise, American Indians, structures, wilderness and parks, wildlife, livestock and poultry, air quality, and health and safety) that are potentially affected by low altitude aircraft. The impacts of low altitude aircraft on these resources are assessed in this chapter. These assessments summarize the case study findings documented in Vol. III and the generic resource assessments in Vol. IV (Appendices A thru J). In addition, an impact classification system is developed for each resource.

4.1 AIRSPACE[1]

4.1.1 Summary of Findings

Airspace Management

Commercial and general aviation air traffic has increased over the past few decades and will continue to increase in the future. Air Force low altitude flying operations also may continue to increase in order to provide realistic training scenarios for U.S. aircrews. These factors, along with population, economic growth, and a greater appreciation of environmental values, have combined to produce today's highly competitive airspace issue.

[1]This section summarizes the analyses included in the case studies section (Vol. III) and the airspace assessment (Vol. IV, Appendix A).

Pursuant to the Federal Aviation Act of 1958, the Federal Aviation Administration (FAA) has responsibility for safety and efficiently managing the Nation's airspace. This includes jurisdiction in approving Air Force proposals for MTRs, MOAs, and RAs and managing the airspace used by the military for low altitude flight training. The Act requires the FAA, in exercising this responsibility, to give full consideration to the requirements of national defense and of commercial and general aviation, and to the public right of transit through the navigable airspace (see Appendix A).

The DOD management of airspace designated for military use is decentralized. Each of the military departments has a central office that sets policy and oversees airspace matters for that department. Joint service airspace issues or inter-service problems are resolved by a DOD headquarters committee, the DOD Policy Board on Federal Aviation, composed of service representatives. Airspace proposals of all departments require review and approval of the sponsoring department's command elements prior to formal submission to the FAA. FAA headquarters has final approval authority for airspace proposals, although requests are first reviewed by, and usually negotiated with, the appropriate FAA local facilities and regional offices. The FAA provides the public with an opportunity to comment on military airspace proposals prior to taking final action. In addition, under military service regulations, all airspace proposals must comply with NEPA. Once approved, the scheduling and use of military airspace is delegated to subordinate commands and units.

The Air Force also plays a role in airspace management, as reflected in Air Force Regulation (AFR) 55-2, *Airspace Management*. Air Force airspace management includes the process of developing proposals for low altitude MTRs, MOAs, and RAs, and working with the FAA and other public and private agencies to establish these types of airspace. The process involves three components: (1) identification of airspace requirements, (2) short and long term planning efforts, and (3) airspace development procedures.

Airspace requirements are determined at the Air Force unit or major command (MAJCOM) level. These requirements stem from three factors: (1) the capabilities of particular aircraft and weapons systems, (2) the location of the base from which particular aircraft operate, and (3) the assigned mission of particular aircraft and tactics associated with that mission.

Short and long term plans for low altitude airspace detail current and future airspace requirements, capabilities, and limitations. They are developed to assist in planning, acquiring, utilizing, and documenting the use of low altitude airspace so that aircrews can establish and maintain proficiency levels in all aspects of low altitude flying operations.

Airspace development describes the process through which low altitude airspace is established for Air Force use. Airspace development proposals, and their accompanying environmental analysis documentation, originate at the unit or MAJCOM level and are scrutinized at several other levels of the Air Force airspace management hierarchy. If they are accepted within the Air Force chain of command, proposals for the establishment of MTRs, MOAs, and RAs, and the environmental analysis supporting them, must receive FAA approval. SRs and LATNs do not require FAA approval. Upon final FAA approval, the airspace is available for Air Force use.

Airspace usage

In 1986, the Air Force controlled 599 low altitude routes, 126 low altitude MOAs, and 88 low altitude RAs over the continental United States. Combined, these training airspaces covered almost one million square miles, or 25% of the total land area of the United States, including Alaska. However, the most heavily utilized airspaces, MOAs and RAs, covered only approximately 5% of the continental United States. MOAs covered approximately 4.3%, while RAs covered only 0.7%. Air Force routes and drop zones covered over 818,900 square miles, and Air Force MOAs and RAs covered 155,329 and 24,844 square miles, respectively. However, airspace usage in the United States is segmented in terms of flight scheduling and altitude structure so that only a portion of this land area is affected at any one time.

In respect to flying operations, there were approximately 50 sorties scheduled per month in 1986 on the average low altitude military training route, but the number scheduled in any given airspace varies. Also, the number of sorties actually flown is usually less than the amount scheduled due to cancellations because of adverse weather conditions and aircraft maintenance problems. The average MOA was scheduled for approximately 422 sorties per month in 1986, and the average RA was scheduled for approximately 647 sorties per month the same year.

Utilization of low altitude airspace can be gauged by an examination of the 12 case study airspaces. Combined, the airspaces cover more than 45,000 square miles in 17 states. Airspace size ranges from 54 square miles (for restricted airspace) to over 10,000 square miles (for a military training route). Five of the airspaces are available to be scheduled by the Air Force 24 hours a day, seven days a week. Six of the airspaces are available from sunrise to sunset local time (though the actual start and end times vary somewhat), and one is available only after four p.m. each day. For currently operating case study airspaces, scheduling and utilization rates range from as low as 6% of available hours scheduled and 40% of scheduled hours utilized to over 75% of available hours scheduled and almost 100% of scheduled hours utilized.

In 1986, there were at least 17 types of aircraft scheduled in all of the case study airspaces combined. The average number of sorties scheduled per month in 1986, typical altitude (feet above ground level), and typical speeds (in knots indicated airspeed and miles per hour) for each of the aircraft types were as follows:

Aircraft type	Average scheduled monthly sorties	Typical altitude (ft AGL)	Typical speed (KIAS)	Typical speed (MPH)
A-10	1,403	300-500	300	345
F-16	618	500-1,000	480	552
F-15	210	500-3,000	480	552
O-2	74	300-500	120	138
T-38	70	500-1,000	400	460
B-52	70	400-500	340	391
F-4	59	500	480	552
RF-4	53	500	480	552
C-130	46	300-1,000	210	242
T-33	24	500-1,000	360	414
FB-111	16	400-500	450	518
F-5	16	500	480	552
A-7	10	500	450	518
B-1B	7	400	560	644
F-111	1	500	480	552
F-14	0.3	500	540	621
A-4	0.1	500	450	518
Total	2,677.4			

Cumulative impacts

There are also at least 80 military training routes, 10 MOAs, and four RAs which are concurrent with the 12 case study airspaces. In these 94 blocks of concurrent airspace, there were over 5,600 scheduled sorties per month. According to the Air Force schedulers responsible for the case study airspaces, the impact of low altitude flights in those airspaces is negligible in terms of conflicts with concurrent airspace. The schedulers attribute this to coordinated scheduling efforts that guard against the simultaneous use of concurrent or crossing airspace. Each case study airspace was assessed for impacts resulting from the additional air traffic at concurrent airspace locations.

Only a portion of the nationwide Air Force low altitude airspace is being utilized at any one time. Air Force schedulers and automated computer systems, such as SAC's Military Airspace Management System (MASMS), coordinate training schedules to ensure that concurrent or crossing military airspaces are not used simultaneously.

4.1.2 Classification of Impacts

Joint use of airspace by civilian and military aircraft is permitted by the FAA for all CONUS airspace with the exception of prohibited and active restricted areas. When airspace designated for military activity is not being utilized, it is available to other users. Nonparticipating aircraft can also enter an active MTR or MOA under visual flight rules (VFR) conditions or when cleared by the appropriate traffic control facility under IFR conditions. The FAA assigns priorities of usage based upon safe operation for all civilian and military aircraft for which a flight plan is filed. Civilian pilots flying under VFR conditions are required to avail themselves of current flight information through Flight Information Publications or Notice to Airmen (NOTAMs). The FAA has written regulations to be observed by all airspace users and issued handbooks (*Procedures for Handling Airspace Matters* and *Special Military Operations*) defining the types of airspace and the operations that may occur therein.

Airspace for low altitude flight operations is typically located away from airports and airfields for safety reasons. As a minimum, low altitude airspace is sited so that no military aircraft fly under 1,500 AGL within 3 nautical miles of an airport. This requirement is to ensure that the potential for conflict between low altitude activity and takeoff/landing operations around airports is avoided. The altitude structure for commercial jet aircraft (typically greater than 10,000 ft AGL) and low altitude military jet aircraft on MTRs (typically below 1,500 ft AGL), results in a negligible impact on commercial airspace usage. Other airspace users such as private or government light aircraft/helicopter pilots operating at lower altitudes (generally below 3,000 ft AGL) under visual flight rules (VFR) may experience some impacts in airspace usage. FAA flight rules requiring "see and avoid" and yield to the aircraft least able to maneuver are designed to reduce the potential for accidents in low altitude airspace. Because VFR traffic is difficult to document, a NEPA analysis for airspace use is not performed in the GEIS. Impacts on governmental agencies engaged in flight operations (National Forest Service, BLM, U.S. Fish and Wildlife) can usually be avoided by early and constant coordination procedures such as those outlined in Vol. II, *EIAP Guide*.

Airspace proposals for Special Use Airspace (SUA), particularly MOAs and RAs, in which military flying activity is required for altitudes greater than 3,000 ft AGL should address the potential for impacts to commercial aviation operations. In 1988 and 1989 the FAA and DOD hosted a series of informal airspace meetings to solicit information from the public concerning the impact of special use airspace. In addition the FAA inventoried all SUA and assigned a rules docket for the formal filing of written comments. In the DOD/DOT Report to Congress "Results of the Joint Review of Special Use Airspace," the study concluded that DOD has a legitimate and continuing need for access to SUA but that there are varying degrees of impact on civil aviation operations. In certain areas, SUA does impact civil aviation by presenting obstacles, both real and perceived, which prevent pilots from flying directly from one point to another. When not available for transit by civil aircraft, SUA must be circumnavigated, which results in inconvenience and added cost due to increased time and distance to be flown. It must be noted that all MOAs and 318 out of 334 RAs used by the military are designated joint use and that DOD/FAA have made extensive investments in both personnel and equipment to allow real-time transit by civil operators through the various SUA.

The report also concluded that civil aviation pilots have misconceptions about SUA or do not receive accurate, complete, or timely information on the status of SUA. As a result, pilots tend to avoid all SUA whether it is active or not. The FAA and DOD have initiated program improvements, and corrective actions are designed to permit a balance between competing interests while maintaining safety within the system. The FAA has established a Military Operations Branch which is a focal point for all FAA/DOD airspace matters and provides real time special use airspace management. Improved utilization reporting procedures are being instituted for SUA and IFR military training routes. In addition FAA/DOD initiatives such as the National Airspace Management Facility (NAMFAC) and Military Airspace Management System (MAMS) will enable automated real-time tracking of SUA utilization so that SUA can be released for civil use when not actually required for military activities. When operational, NAMFAC and MAMS will provide the data needed to monitor utilization trends and to make decisions regarding the need for modification or revocation of SUA.

4.2 SOCIAL[2]

4.2.1 Summary of Findings

4.2.1.1 *Background*

Scientific studies of the impacts of low altitude flying operations on individuals and communities are scarce. Most studies address social impacts of aircraft in the vicinity of airports and air bases. They tend to regard noise as virtually the only source of impact and annoyance with noise as the major outcome. Generally, what is of particular interest to researchers and planners is the percentage of people who are highly annoyed at certain noise levels. However, flight frequency and the context both of flights and the kinds of areas overflown differ markedly between airports or air bases and Air Force low altitude airspace operations. Therefore, research findings from these studies may have only limited applicability to low altitude flying operations.

Although annoyance is a useful way to gauge human responses to low altitude flights, a more inclusive notion that emphasizes intrusion from all aspects of the flights provides a more thorough means of understanding impacts. This expanded concept of annoyance is in line with the findings of researchers who recognize multiple and non-noise inputs to annoyance. In addition, evidence from risk perception literature suggests that the meanings associated with noise sources—in part influenced by the setting in which the noise occurs—may determine the ways in which humans respond, rather than noise levels per se.

[2]This section summarizes the analyses included in the case studies section (Vol. III) and the social assessment (Vol. IV, Appendix B).

The literatures on responses to aircraft and on risk perceptions, together with previous experience conducting environmental assessments, led to the development of a social impacts model for low altitude military flights. This model suggests that the flights (composed of a host of noise and non-noise characteristics) acquire meaning when filtered through social context. Social context is comprised of interactions between the physical environment, individuals and their past, and institutions and their history; it also is affected by outside influences. The meaning flights acquire through social context determines the nature and extent of social impacts. The Social Impacts Model guided data analyses and interpretations.

The social impacts research for the GEIS was conducted in conjunction with the 12 case studies discussed elsewhere. Three databases were used to identify and assess social impacts for case study airspaces. The Airspace Database contains information on the configuration and use of low altitude military airspace in the United States (see Sect. 1.4 and Appendix A). It also provides information about the 1980 population, land area, and population density beneath military airspace. Thus, the Airspace Database depicts the potentially affected population in terms of its exposure to low altitude military flights.

A second database stores the data gathered through 721 surveys conducted with people who live or work beneath the 12 case study airspaces. Pertinent information includes demographic characteristics of the survey respondents as well as their self-reported responses to low altitude flying operations. This information provides a basis for assessing human and community impacts in terms of annoyance and interrupted activities. It also gives background information on individual awareness of, and support or opposition to, the operations that helps to identify potentially sensitive receptors.

The third database contains the results of 507 telephone interviews conducted with key informants—local government officials and newspaper editors representing communities beneath the case study airspaces. This database provides an indication of community awareness, community disruption, and formal complaints associated with Air Force low altitude flying operations. It also helps identify the extent to which sensitive receptors may or may not be affected by the flights.

The degree to which humans and communities are aware of, and affected by, flights in low altitude airspace is related to attributes both of the flights and of the populations overflown. These attributes are categorized as aircraft noise, aircraft exposure, and social characteristics. Aircraft noise variables for this study are the onset rate-adjusted monthly day-night average A-weighted sound level, L_{dnmr}, and sound exposure level (SEL, more easily conceptualized as instantaneous noise level). Aircraft exposure variables are airspace type, aircraft type, total scheduled sorties, and number of concurrent low altitude flight segments. Social characteristics are knowledge of purpose of flights, perceived altitude, support for the military, age, sex, population density, and fear of crashes. Interrupted activities and annoyance, which alone are impacts of low altitude flights, also can influence other impact and impact-indicator categories.

GEIS research was designed to investigate such questions as if people are aware of military low altitude flights; if and how they are affected by the flights; if they are affected adversely by the flights to the extent that, as individuals or in groups, they take action in response to the flights; and what social characteristics and flight parameters are associated with impacts.

Presented below are the GEIS results showing the distribution of responses to key questions and identify the statistical correlates of (1) affected populations' awareness of Air Force low altitude flights, which is a precondition for social impacts and (2) the social impacts and impact indicators resulting from those flights. Tables 4.2.1 and 4.2.2 present the data in greater detail.

4.2.1.2 *Precondition for impacts*

Awareness of flights is a precondition for annoyance and disruption. Therefore, awareness is basic to an assessment of the impacts of low altitude flying operations. Most of the respondents[3] surveyed beneath the case study airspaces (618, or 86.2%) were aware of low altitude military flights in the vicinity. Likewise, most local government officials and newspaper editors representing communities beneath the case study airspaces (395, or 77.9%) were aware of flights in their area.

Awareness is related more to flight characteristics than social characteristics. The higher the L_{dnmr}, the greater the awareness of flights (see Fig. 4.2.1); SEL did not correlate significantly[4] with awareness (see Fig. 4.2.2). Respondents' awareness also was related significantly to airspace type, where awareness was greater under Instrument Routes (IRs) than other airspaces. Aircraft type also correlated with awareness; respondents reported greatest awareness where attack aircraft (e.g., A-10s) fly. While the number of concurrent airspaces related positively to awareness, there was not a significant relationship between total scheduled sorties and awareness. This difference may be due to the influence of airspace type and aircraft type. Respondents' awareness of flights increased as they reported the existence of more nearby noise sources (other than military aircraft). The reasons for this finding are unclear. One social characteristic

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[3]The term "respondents" refers to interview responses per interview location. Sampling units were structures, and more than one individual could be interviewed at a single structure. For scaled questions, all responses from a structure were averaged to make a single response. For open-ended questions, all different responses were used in analysis; duplicate responses were counted only once.

[4]In discussions of findings, the term "significant" refers to statistically significant results.

Table 4.2.1. Factors associated with awareness of, support for, and informal complaints about flights[1]

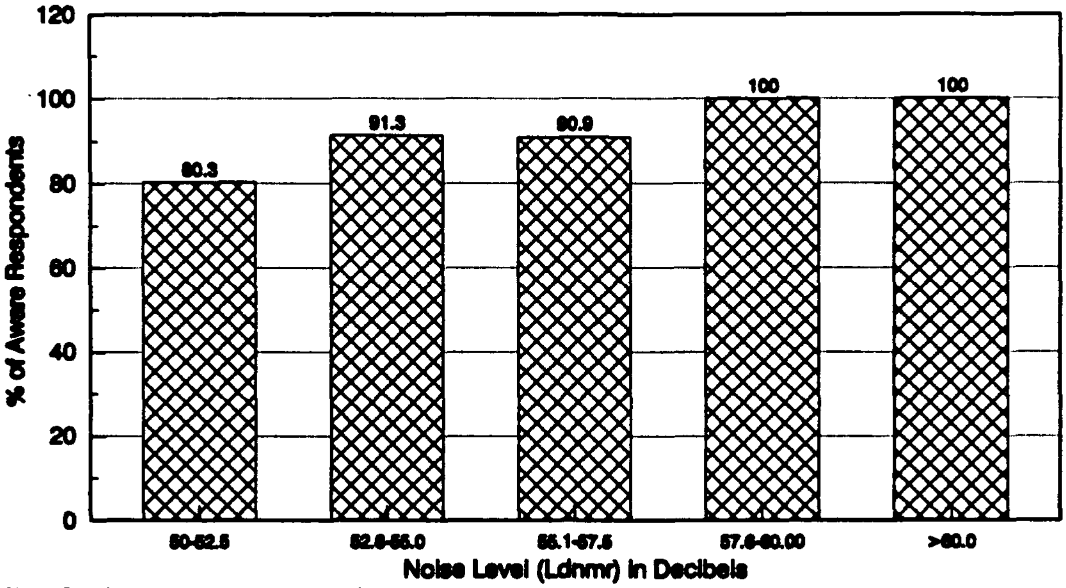
Characteristics	Awareness	Support for flights	Informal complaints
<u>Social characteristics</u>			
Knowledge of purpose of flights	--	Sig.	None
Perceived alt.	--	Sig.	None
Support for military	--	Pos.	Sig.
Age of respondent	None	Pos.	--
Sex	--	Sig.	--
Population density	Neg.	Neg.	None
Fear of crashes	--	Neg.	Sig.
Interrupted activities	--	Neg.	Sig.
Annoyance	--	--	Sig.
<u>Noise characteristics</u>			
L_{dnmr}	Pos.	None	None
SEL	None	Neg.	None
<u>Exposure characteristics</u>			
Airspace type[2]	Sig.	Sig.	Sig.
Aircraft type[3]	Sig.	Sig.	None
Total sorties	None	None	Sig.
Number of concurrent segments	Pos.	None	None

[1]Pos. = Positive, statistically significant relationship, from simple regression analysis.
Neg. = Negative, statistically significant relationship, from simple regression analysis.
Sig. = Statistically significant relationship, from Analysis of Variance-direction not indicated.
None = No statistically significant relationship
-- = Not tested.
[2]Airspace type includes relationship for airspace type alone and for the number of sorties by airspace type.
[3]Aircraft type includes relationship for aircraft type alone and for the number of sorties by aircraft type.

Table 4.2.2. Factors associated with annoyance and interrupted activities[1]

Characteristics	Annoyance	Interrupted activities
<u>Social characteristics</u>		
Perceived altitude of flights	Sig.	Sig.
Support for military	Neg.	Neg.
Support for flights	Neg.	Neg.
Presence of young	Pos.	Pos.
Present of elderly	Neg.	Neg.
Population density	None	None
Concern about crashes	Pos.	Pos.
Interrupted activities	Pos.	Pos.
<u>Noise characteristics</u>		
L_{dnmr}	None	None
SEL	Pos.	Pos.
<u>Exposure characteristics</u>		
Airspace type[2]	Sig.	Sig.
Aircraft type[3]	Sig.	None
Total number of sorties	None	Pos.
Number of concurrent segments	None	None

[1]Pos. = Positive, statistically significant relationship, from simple regression analysis.
Neg. = Negative, statistically significant relationship, from simple regression analysis.
Sig. = Statistically significant relationship, from Analysis of Variance-direction not indicated.
None = No statistically significant relationship
-- = Not tested.
[2]Airspace type includes relationship for airspace type alone and for the number of sorties by airspace type.
[3]Aircraft type includes relationship for aircraft type alone and for the number of sorties by aircraft type.



Note: Only 3 households were exposed to Ldnmr greater than 60 dB. Ldnmr data are available for only 4 airspaces (398 households).

Fig. 4.2.1. Awareness of flights by average noise level.

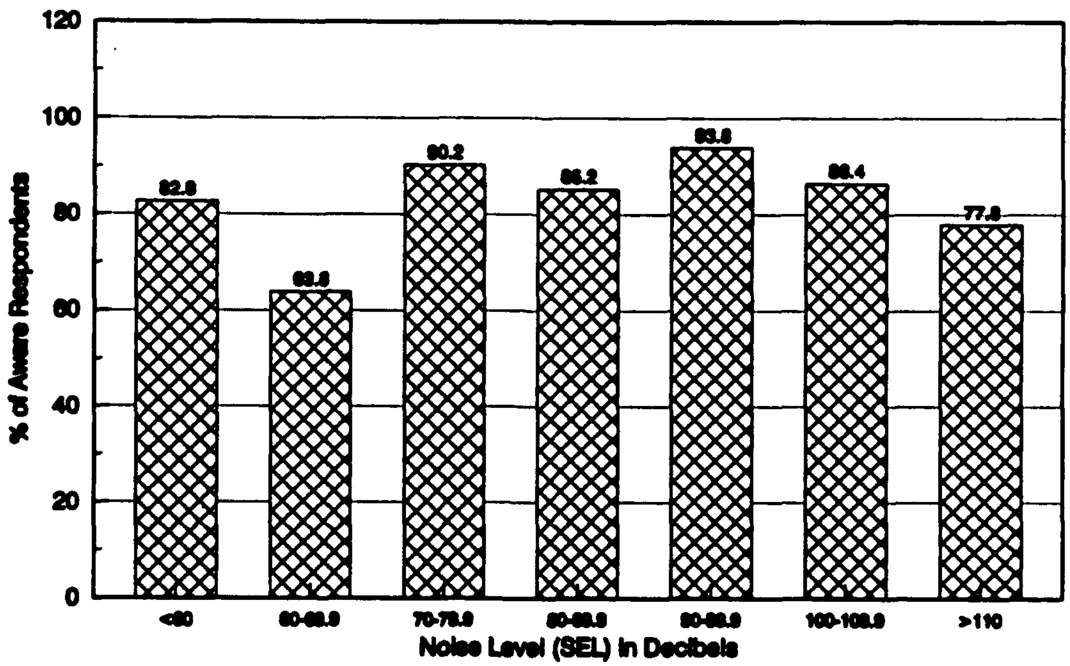


Fig. 4.2.2. Awareness of flights by peak noise level.

significantly related to awareness is population density; the higher the population density, the fewer people are aware of low altitude flights.

4.2.1.3 *Impacts*

Annoyance

Overall, GEIS findings indicate that a moderate level of annoyance exists under case study airspace. Annoyance varies among case studies; generally between 25% and 40% of the respondents reported being highly annoyed. In only one case study, a MOA, where 47.5% of the respondents indicated they were highly annoyed with at least one aspect of the flights, was annoyance sufficient to be considered a high impact. Nearly one-third of all field survey respondents (230, or 32.3%) reported being highly annoyed with at least one of four aspects of the flights. One hundred forty-one respondents (20.2%) reported high annoyance with the possibility of an aircraft accident, 136 (19.2%) reported high annoyance with aircraft noise, 130 (18.3%) reported high annoyance with the altitude of the flights, and 50 (7.1%) reported high annoyance with the presence of the flights.

Conversely, nearly half of the respondents from the case study sites (348, or 48.8%) reported low or no annoyance with the flights on all four annoyance variables. Five hundred ninety (83.5%) reported low or no annoyance with the presence of the flights, 487 (68.6%) with the altitude, 468 (67.0%) with the possibility of an aircraft accident, and 427 (60.4%) with aircraft noise.

Social characteristics are more strongly related to annoyance than are noise and exposure characteristics. Annoyance is higher under the following social conditions: (1) less support for the military; (2) less support for the flights; (3) lower perceived altitude of flights; (4) greater presence of young children in households; and (5) more reported activity disruption. In addition, as annoyance with the possibility of the aircraft crashing increases, so does annoyance with noise, the presence of the flights, and the altitude of the flights.

SEL is significantly related to annoyance (see Fig. 4.2.3) but there is no correlation with L_{dnmr} (see Fig. 4.2.4). The higher the SEL, the higher the levels of reported annoyance. Reported annoyance is higher under IRs and lower under SRs. Additionally, the presence of fighter aircraft are associated with the highest levels of annoyance, and cargo planes with the least annoyance.

The importance of the high levels of annoyance reported by many respondents is unclear. Thus, the "high" annoyance reported here might not have much overall importance in people's lives and may not be disruptive. Several pieces of evidence indicate that the impacts of low altitude flights may not affect people strongly. First, when asked what they did not like about the area in which they live before any specific aircraft-related questions were posed, only four (0.6%) of the 721 respondents mentioned the flights. By contrast, many more respondents reported disliking some social or physical aspects of the area (40.9 and 20.7% of respondents, respectively). Second, only 14 (1.9%) of the respondents ever had complained about the flights formally and only 12 (2.4%) of the community officials contacted beneath the case study airspaces reported incidents of community disruption. Third, nearly 80% of the respondents either supported the flights (262, or 43%) or neither supported nor opposed them (220, or 36%). Fourth, a majority of the respondents (61%) reported liking some aspect of the flights. These findings indicate that people may have ambivalent feelings about the flights and that relatively few people are spurred into action, despite their annoyance.

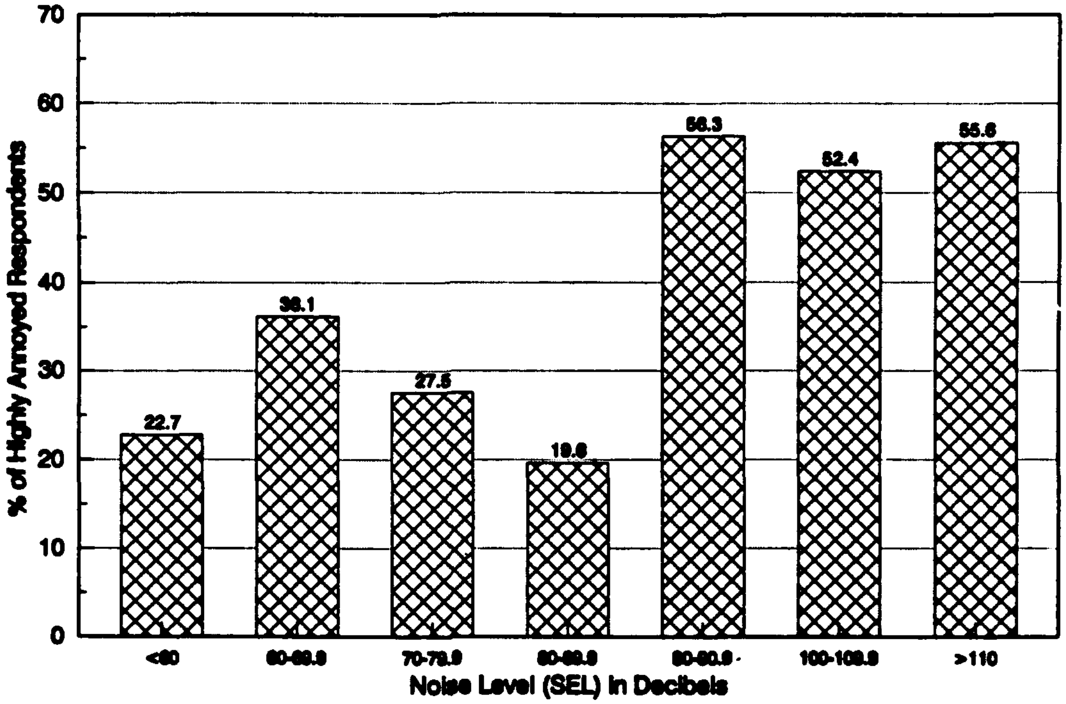
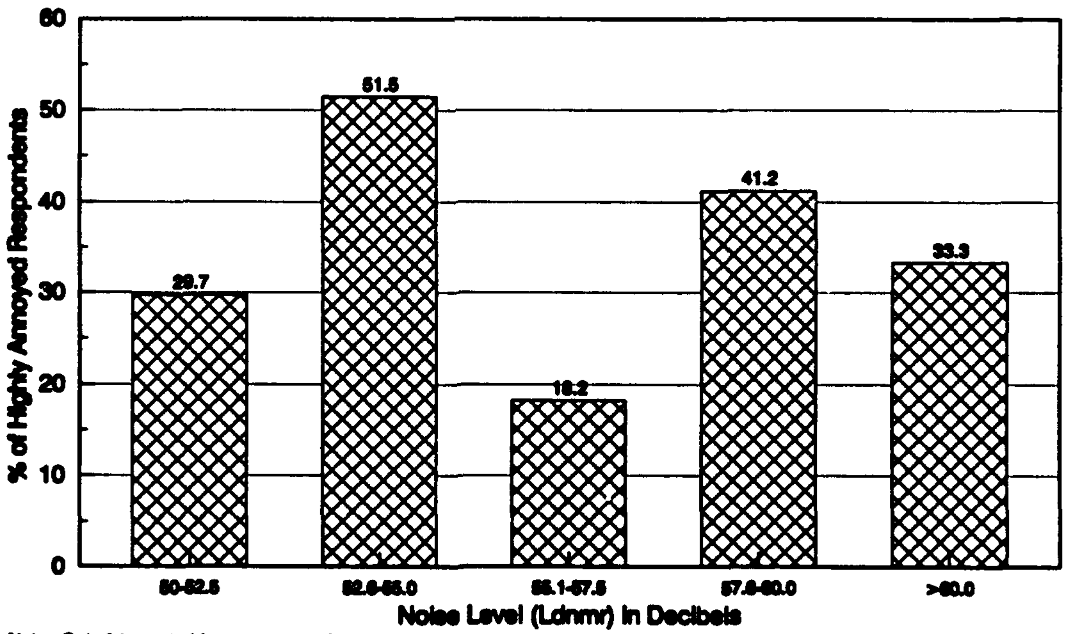


Fig. 4.2.3. Annoyance by peak noise level.



Note: Only 3 households were exposed to Ldnmr greater than 60 dB. Ldnmr data are available for only 4 airspaces (306 households).

Fig. 4.2.4. Annoyance by average noise level.

Interrupted activities

Respondents were asked how often during the previous (or a typical) month they were interrupted by the flights while engaged in the following activities: sleep, personal conversations, watching television or listening to the radio, reading or concentrating, or work activities. Respondents also were asked about interruption of their childrens' activities.

Almost one-fifth of the respondents (140, or 19.7%) beneath the case study airspaces reported either sleep interruption or interruption of three or more non-sleep activities. These results constitute a moderate impact overall (see Sect. 4.2.2). The case study respondents' reports of interruption of sleep or at least three non-sleep activities vary somewhat among airspaces, but the differences are not statistically significant. For instance, interrupted activities are a high impact in two case study airspaces where 33.3% and 30.5% of the respondents, respectively, reported sleep interruption or interruption of three or more non-sleep activities during the preceding month. Of all the field interview respondents, 70 (10.1%) reported sleep disruption. Twenty-six respondents (3.7%) reported the interruption of three non-sleep activities, 33 respondents (4.7%) reported the interruption of four of these activities, 38 (5.4%) reported the disruption of five non-sleep activities, and 14 (2.0%) reported the interruption of six non-sleep activities. On the other end of the scale, 440 respondents (62.1%) reported no interruption of non-sleep activities, 100 (14.1%) reported the disruption of one, and 57 (8.1%) reported the disruption of two such activities.

Like annoyance, interrupted activities are more strongly related to social characteristics than to noise or exposure characteristics. Increased disruption is reported where support for the military, support for the flights, and perceived altitude of flights is lower and in households with young children. Also, the greater a person's annoyance with the possibility of a crash, the more likely the person is to report being interrupted by the flights.

As with annoyance, reports of interrupted activities increase where SEL is higher (see Fig. 4.2.5), but are not related statistically to L_{dnmr} (see Fig. 4.2.6). Activity disruption increases as total scheduled sorties increase. And, more disruption is reported under MOAs than other airspace types.

Community disruption

Public controversy and social group formation are components of community disruption. On the whole, it seems that levels of community disruption are negligible to low beneath the case study areas, but in some other locations citizen action groups have coalesced to protest and oppose Air Force and other military flight activities (see also Appendix F). GEIS research on social impacts of the flights revealed little evidence of community disruption. Very few respondents to GEIS face-to-face surveys reported that they were aware of citizen protest groups or indicated that they were members of such groups. (This situation did change, however, on one case study MTR where publicity associated with a change in operations after the survey created public opposition [McTaggart 1989]). In telephone interviews, knowledgeable community officials and newspaper editors generally reported low levels of community disruption in areas affected by case study airspaces.

However, GEIS scoping meetings and interviews with organized citizen action group officials (for GEIS research on impacts to wilderness users) indicated that there is some public antagonism toward the military. This antagonism largely resulted from an initial lack of communication with, and response from, the Air Force about issues of public concern. Over time, such antagonism toward the Air Force and other branches of the

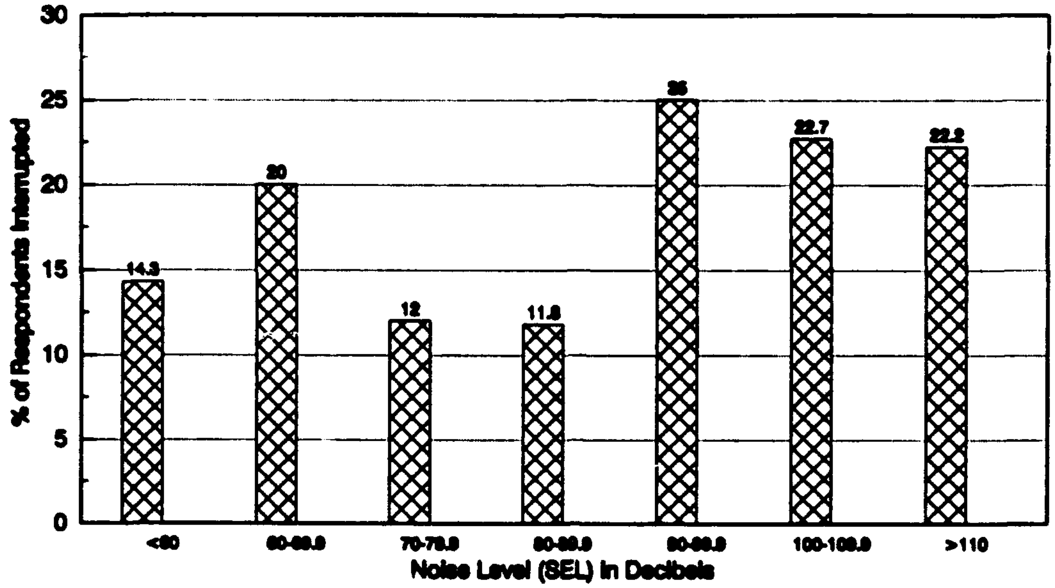
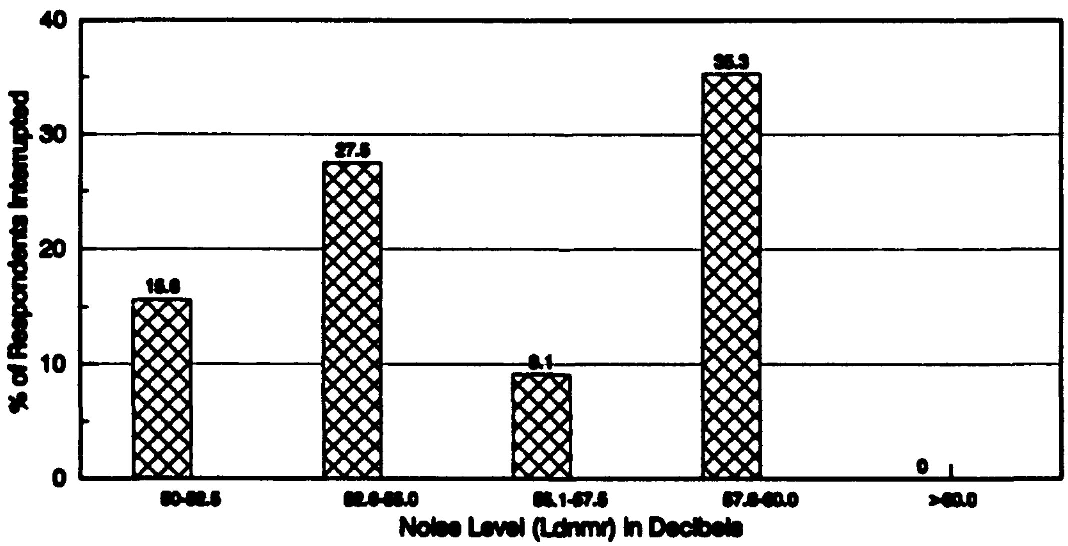


Fig. 4.2.5. Interrupted activities by peak noise level.



Note: Only 3 households were exposed to Ldnmr greater than 60 dB. Ldnmr data are available for only 4 airspaces (386 households).

Fig. 4.2.6. Interrupted activities by average noise level.

military appears to have escalated possibly because communication has not improved. Interviews with representatives of citizen action groups indicate that the groups have launched membership recruitment drives and have organized public confrontational activities such as national call-ins.

Reduced livestock productivity

Thirty-two (6.3%) of the local officials and newspaper editors interviewed were aware of reported losses in productivity from commercial livestock operations beneath the case study airspaces. Overall, impacts in this category are low. Another indication that the impacts on livestock are low comes from field interviews. When asked what they dislike about the flights, 27 respondents (less than 4%) mentioned disruption of domestic animals.

Disturbance of young in group facilities

Two (0.4%) of the local officials and newspaper editors contacted had received complaints regarding the disturbance of the very young in group facilities beneath the case study airspaces. This constitutes a low level of impact. Outside of the group facility context, 18 field survey respondents (less than 3%) reported disruption of young children as a distasteful aspect of low altitude flights.

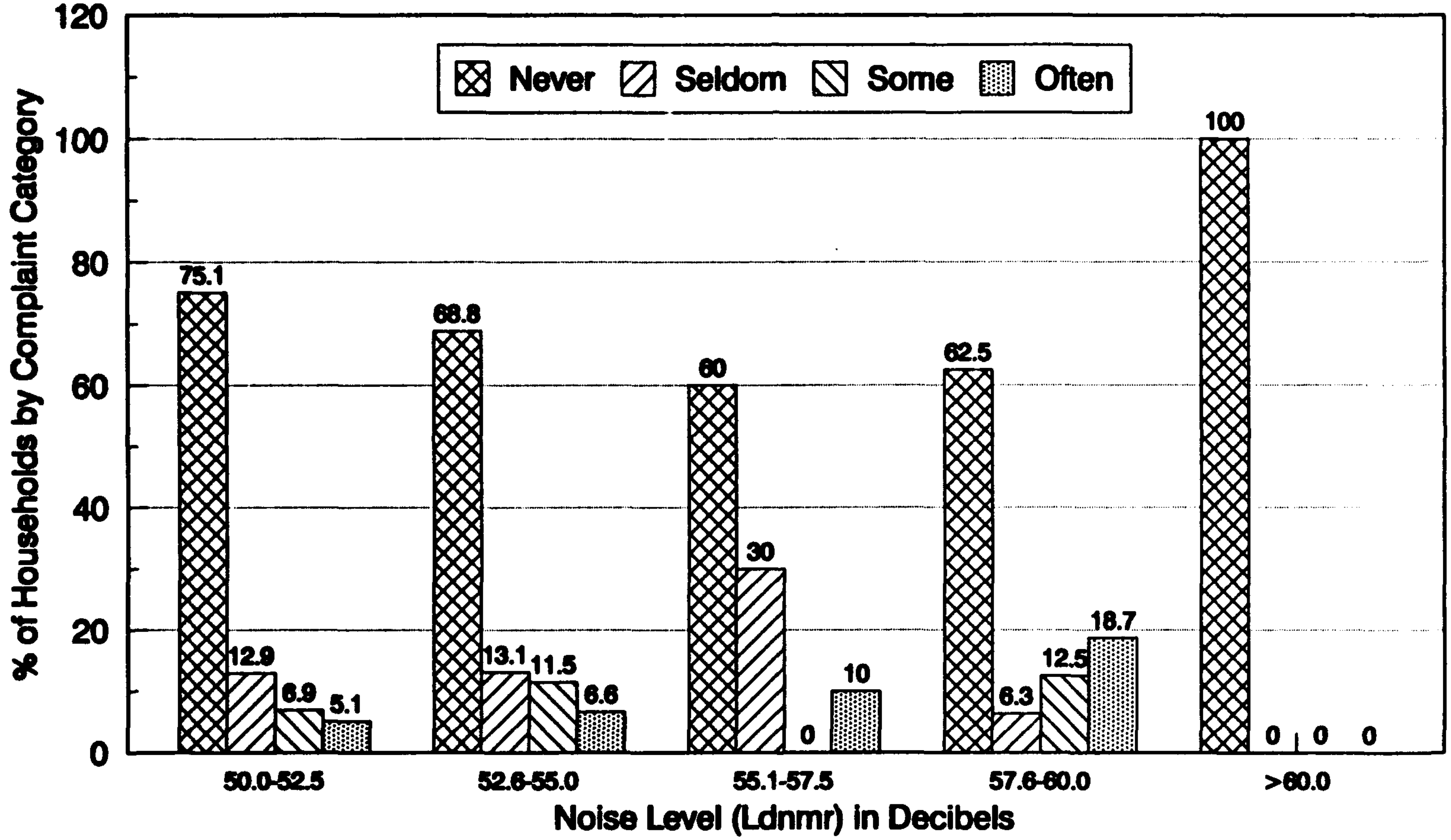
4.2.1.4 *Impact indicators*

Complaints

Impact indicators are complaints, support for the military, and support for the flights. Complaints can be registered either formally to officials or informally to friends or family members. Formal complaints about low altitude flights apparently are uncommon. Of the respondents surveyed beneath the case study airspaces, only 14 (1.9%) said that they had made one or two formal complaints about the low altitude flights. About one-quarter (26.1%) of the key informants reported having received complaints about low altitude flights. However, it is not known whether these complaints were about case study airspaces or other low altitude flight activities in the area.

Informal complaints to friends or family members are more common than formal complaints. Of the 164 (23.4%) respondents who reported having made informal complaints, 39 had complained more than once a month, 41 had complained between once a month and three times a year, and 84 had complained three times a year or less. There is a significant difference among case study airspaces with regard to the frequency of informal complaints.

Informal complaints are greater where support for the military is lower and where the perceived number of low altitude flights is higher. Additionally, informal complaints increase as do reported annoyance (with one or more of the annoyance variables and with annoyance with the possibility of aircraft crashes) and interrupted activities (sleep interruption or disruption of three or more non-sleep activities). The case studies do not indicate a systematic relationship between informal complaints and either average or instantaneous aircraft noise levels (see Figs 4.2.7 and 4.2.8). However, there are more informal complaints where there are more total scheduled sorties. Informal complaints are more frequent under IRs and Visual Routes (VRs) than under Military Operations Areas (MOAs) and SRs.



Note: Only 3 households were exposed to Ldnmr greater than 60 dB. Ldnmr data are available for only 4 airspaces (398 households).

Fig. 4.2.7. Informal complaints by L_{dnmr}.

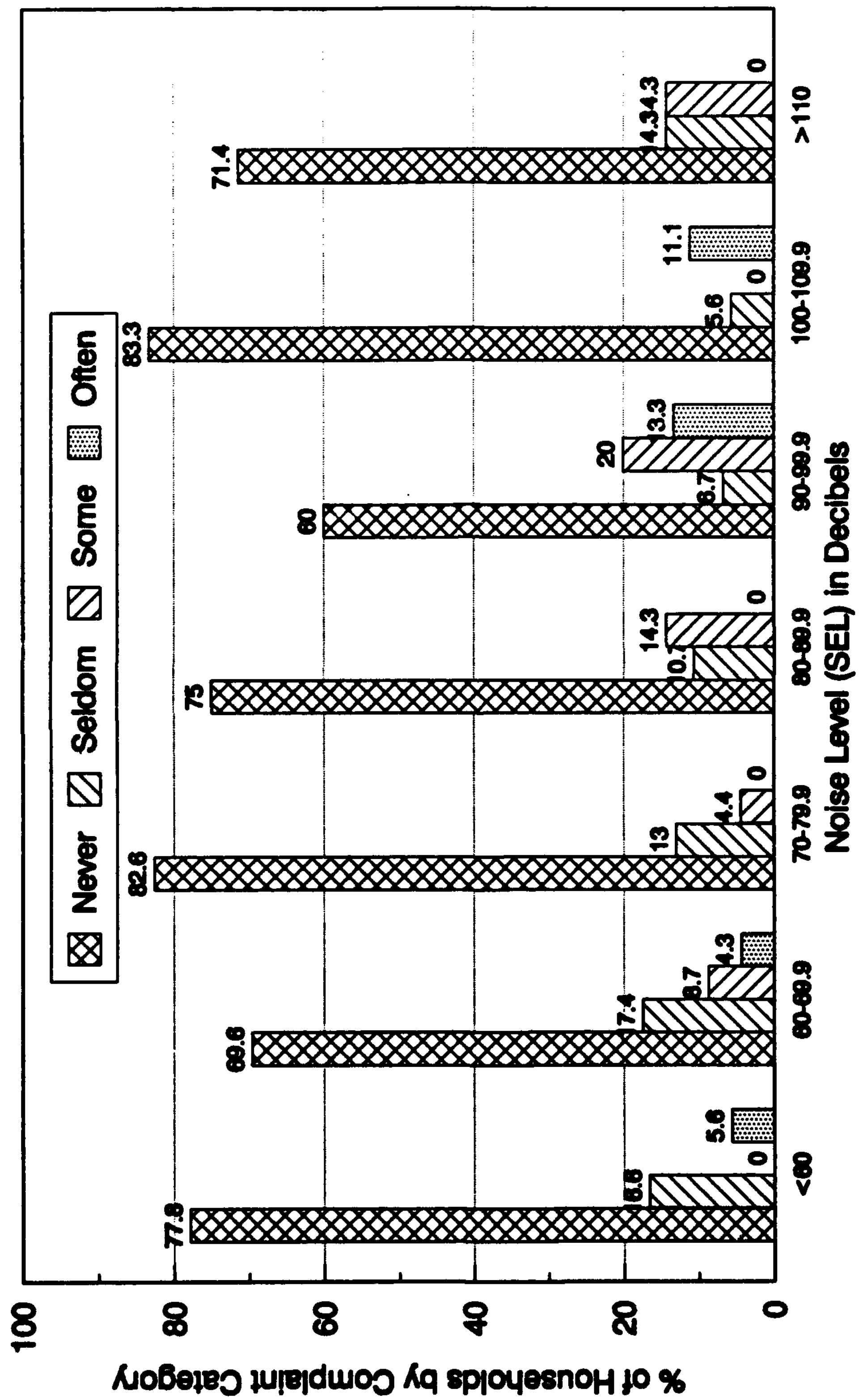


Fig. 4.2.8. Informal complaints by peak noise level.

Support for flights

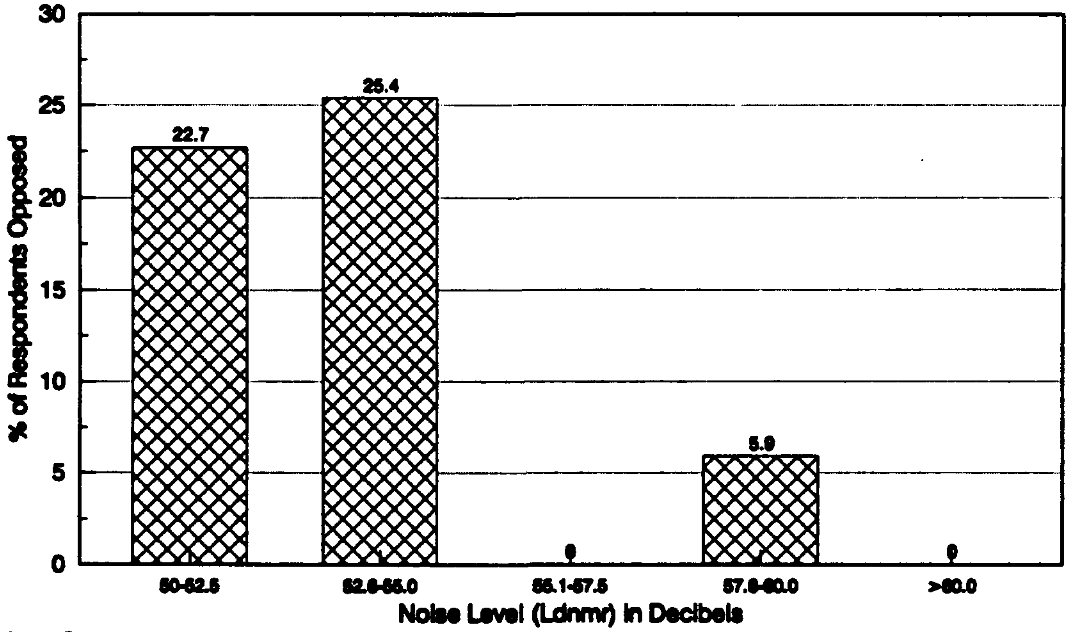
Over two-fifths (262, or 43.1%) of the respondents supported or strongly supported the flights and over one-third (220, or 36.2%) of the respondents neither supported nor opposed them. About one-fifth (122, or 20.1%) of the respondents reported other opposition and strong opposition to the flights. The case study data indicate that there is a significant difference between airspaces in terms of opposition to the flights.

Flight support is related significantly to several social characteristics. Flight support is higher with greater (1) support for the military, (2) knowledge about the purpose of the flights, (3) perceived altitude of flights, and (4) age. Such support also is higher where there is lower (1) population density, (2) concern about crashes, and (3) reports of activity interruption. In addition, men tend to support flights more than do women.

Most flight parameters are not significantly related to flight support. For example, L_{dnmr} does not correlate with flight support (see Fig. 4.2.9); however, as SEL increases, flight support decreases (see Fig. 4.2.10). Flight support is greater under IRs and SRs than under other airspaces as well as where cargo planes rather than other kinds of aircraft fly.

Cumulative impacts

Several low altitude airspaces can cross a single point. The impacts of these concurrent airspaces constitute cumulative impacts. For case study analyses, information about concurrent airspaces was analyzed for four airspaces for which there were a total of 396 interviews. In those airspaces, nearly half (48.7%) of the field interviews were conducted under multiple low altitude airspaces. The highest number of concurrent



Note: Only 3 households were exposed to Ldnmr greater than 60 dB. Ldnmr data are available for only 4 airspaces (396 households).

Fig. 4.2.9. Opposition to flights by L_{dnmr}.

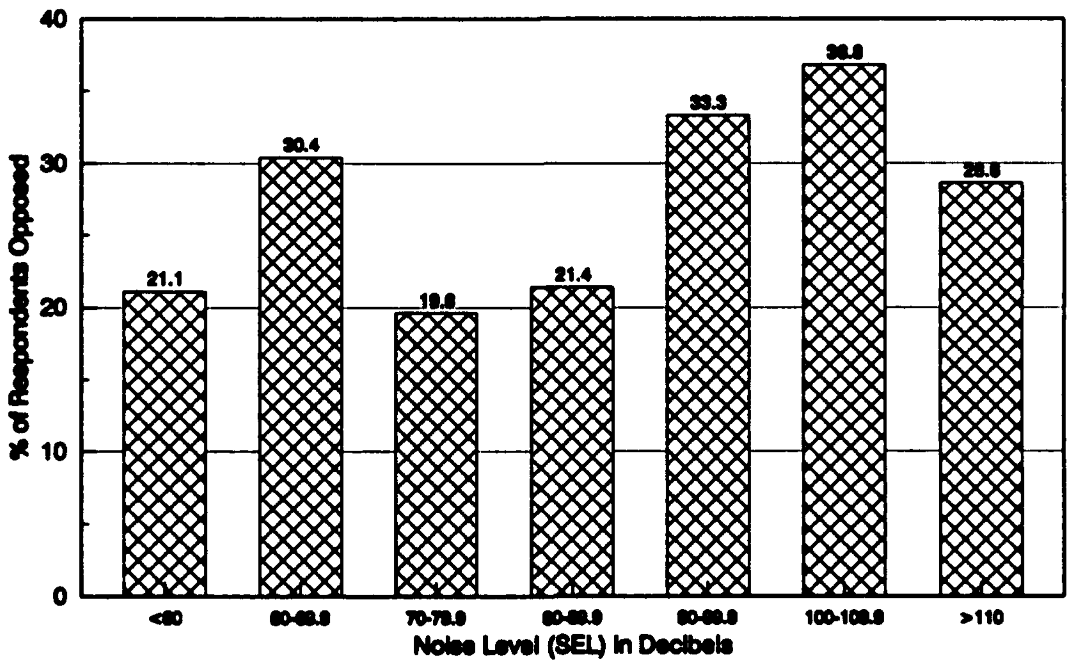


Fig. 4.2.10. Opposition to flights by peak noise level.

airspaces in this subset of case study sites was six. Nearly half (48.7%) of the respondents under concurrent airspaces lived under three or more low altitude airspaces.

Data collected from key informants and respondents under concurrent airspaces are difficult to interpret. This is because it is unclear to which flights people are responding when they report being affected. Nevertheless, from analyses of face-to-face interview data, the number of concurrent airspaces was related statistically only to awareness of flights. Where there were more concurrent airspaces, there was greater awareness of low altitude flights.

However, the category of 'concurrent airspaces' subsumes other flight parameters, most notably total scheduled sorties, airspace type, and aircraft type. Case study analyses indicate that awareness of flights is greater under IRs and where the aircraft type is fighters. Support for low altitude flights is greater under IRs and SRs than other airspace types and is greatest where cargo planes fly. Higher annoyance levels are reported under IRs; lower annoyance levels are reported under SRs. Reported annoyance also is highest where fighters fly and lowest where cargo planes fly. Respondents indicate that more of their activities are interrupted under MOAs and where there are more scheduled sorties. Finally, the incidence of informal complaints is higher under IRs and VRs and where there are more scheduled sorties; fewer informal complaints are reported under MOAs and SRs. Some of these findings may seem contradictory for two related reasons. Each of the exposure variables explain relatively little of the variation in survey responses and phenomena like annoyance and informal complaints are influenced in complex ways by a host of factors. Therefore, it is not surprising that statistical relationships between two factors (e.g., activity interruption and informal complaints) do not seem to hold in the face of a third, different factor (e.g., MOAs).

4.2.2 Classification of Impacts

The impacts of Air Force low altitude flight operations are annoyance, disruption of activities, community disruption, disturbance of the young in group facilities, and disturbance of livestock productivity. In certain contexts, some impacts (e.g., annoyance, disrupted activities) may not have much importance in the overall scheme of people's lives. Indeed, many aspects of everyday life may annoy many people, but those annoyances are tolerated because they cannot be avoided without undue effort or expense. Similarly, flights may affect a large number of people, but may not cause community disruption. Therefore, discrete and easily identifiable categories of impacts are difficult to create.

It is not possible to predict specifically how people will respond to either new or altered flight activities. There is no scientific basis for estimating how people will respond to announcements of proposed airspaces or airspace changes or for estimating initial responses to new or changed flight activities. Further research is necessary to provide a basis for such predictions. This research ideally would investigate the same people over time. The following periods of time would be appropriate to study: (1) before proposed flight activities are announced; (2) the announcement, public meeting, and assessment stages; (3) soon after new flights or altered flight activities begin; and (4) at least one period of time well after flight operations have been in effect. However, research conducted for the GEIS resulted in a description of, and some bases for predicting, social impacts from existing low altitude Air Force flight activities.

One of the impact categories, annoyance, is experienced by individuals. Determining levels of annoyance under existing airspace would be accomplished directly by interviewing affected people and figuring the percentage of people who are highly annoyed. Individuals' annoyance with flights can vary over time and is virtually impossible to predict in the absence of existing flights. Annoyance can be directed toward certain aspects of the flights (e.g., their noise, presence, altitude, or potential crashes—here referred to as global annoyance variables) or toward the activity-specific effects of the flights (e.g., the effects of noise on sleep, conversations, reading). As described in Appendix B, the global annoyance variables are more useful than characteristics of the flights themselves in understanding the impacts of low altitude flying. A pre-condition of annoyance, or any of the impacts described here, is awareness of the flights. While physical parameters like noise and aircraft visibility may generate the awareness of flights, the meaning attached to the flights may have its source in attitudes, beliefs, events, and experiences directly or indirectly associated with the flights, the military, or the aircraft.

Based on GEIS surveys, one can predict that levels of annoyance typically will range from 25 to 40% (after flights have been in effect for some period of time). More specific predictions are most appropriate when comparing alternative locations for low altitude airspaces. In that context, higher levels of annoyance can be expected where there is less support for the military and where there are more households with young children. In areas with existing low altitude flights, annoyance is likely to be greater where there is less support for such flights. Anticipated annoyance also will be greater where aircraft are expected to produce higher instantaneous sound levels (SEL).

Interruption of activities such as working, talking on the telephone, watching television, or sleeping is another category of adverse impacts to individuals. Levels of impact are based on relative numbers of people whose activities are interrupted. Other than observation, the most direct way to determine such impacts is by interviewing affected individuals and estimating the percentage of people who experience different levels of activity interruption. Like annoyance, specific levels of activity interruption may change over time and are extremely difficult to predict for new or changed airspaces. Further, the meaning people attach to activity interruption determines the extent to which such interruption is bothersome and influences what actions people might take because of the interruption.

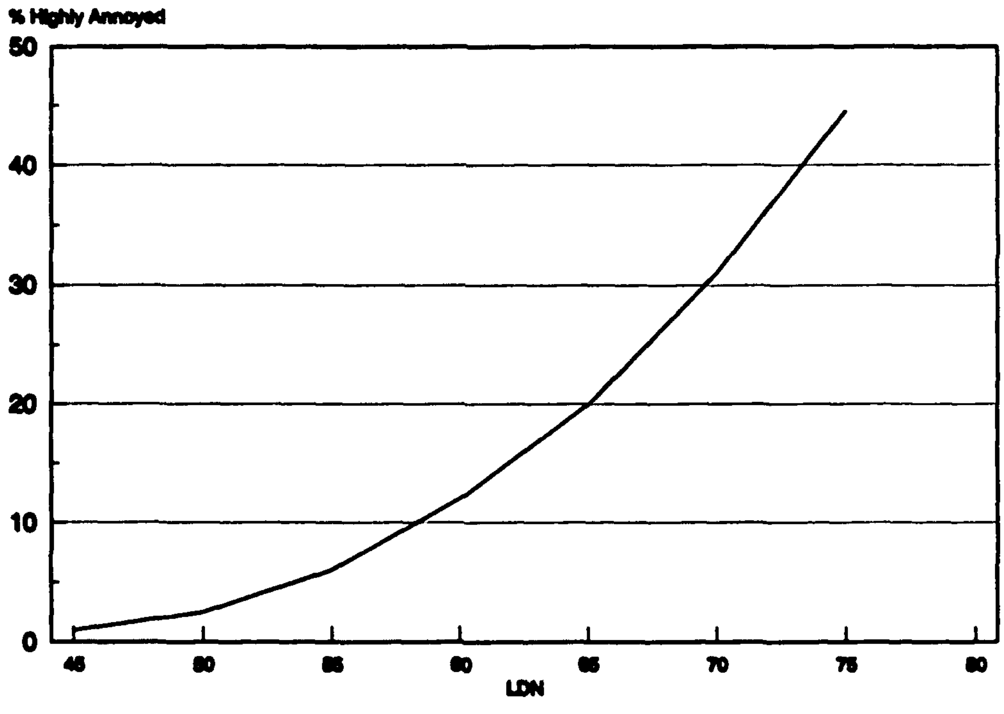
GEIS survey research indicates that reported activity disruption from existing low altitude flights will range from about 14 to 33%. Like annoyance, more specific predictions of activity disruption are most appropriate when comparing potential airspace locations. Again, as for annoyance, activity disruption is likely to be greater where there is less support for the military, less support for low altitude flights (where there are existing activities), and where there are higher percentages of households with young children. Interrupted activities also are apt to be greater where planned activities will produce higher SEL and a larger number of sorties.

Community disruption is a category of impacts relevant to the group of people who live or work beneath Air Force low altitude airspaces. Communities of affected people therefore may not correspond with political or geographic boundaries. Community disruption is measured by public controversies and expressions of displeasure about the flights. As groups form and expend time and resources on the issue, the defined level of community disruption may increase. At this point, there is not a reliable way to predict where community disruption will occur; it can be measured only once it has occurred or while it is occurring. Community disruption may be influenced by the degree to which the meanings associated with the flights encourage groups of people to engage in political actions as a way of expressing dissatisfaction with the flights. Flight awareness, together with annoyance and interrupted activities caused by flights, are likely to contribute to community disruption by forming a pool of people who potentially can be galvanized into action.

Levels of initial community disruption resulting from low altitude flying can be predicted early in the airspace planning process. At public meetings and/or scoping meetings, the size of the turnout, the number of social groups represented, and the vehemence with which any position (especially opposition) is voiced all provide clues about the potential for high community disruption impacts. Where social groups form or become active in such activities as membership recruitment and organized protests one also can expect high community disruption impacts. Newspaper articles, editorial opinions, and letters to newspaper editors as well as complaints to and inquiries of public officials also are indicators that enable one to predict high levels of community disruption. However, it is not possible to predict specifically how levels of community disruption will change over time. GEIS face-to-face and telephone surveys indicate that, typically, levels of community disruption will be negligible or low after flight activities have occurred for some period of time.

Flights also may affect certain categories of people in distinctive ways. These categories include young children as well as farmers and ranchers. GEIS research indicates that households with young children, particularly, are prone to being affected adversely by aircraft flights. Thus, congregations of young people in group facilities may be hotspots of adverse impacts and are considered to be a separate impact category. Farmers and ranchers may suffer negative economic effects if low altitude flights disturb their livestock, especially if the flights reduce productivity for commercial livestock operations. Therefore, economic disruption of livestock operations is an additional impact category. Large livestock operations (e.g., large feed lots) potentially can be sites of high impact.

Current Air Force procedures for describing the noise environment along military training routes and estimating annoyance impacts to individuals are based on the ROUTEMAP computer model. ROUTEMAP predicts the level of annoyance (i.e., the probability of people being highly annoyed) for intermittent events under low altitude military training routes using predicted noise levels as an indicator. The noise-annoyance relationship is based on airport/airbase and other transportation related noise research and is shown in Fig. 4.2.11. The noise measurement normally used around airbases and airports is the day-night average sound level, L_{dn}, which incorporates a 10 decibel penalty for noise occurring during the sensitive times of the day (10:00 p.m.-7:00 a.m.). ROUTEMAP computes an adjusted day-night average sound level, L_{dnmr}, that incorporates an additional penalty (up to 5 decibels) for the sudden onset of fast, low flying aircraft characteristic of military training routes.



Source: Adapted from National Academy of Sciences, 1977. "Guidelines for Preparing Environmental Impact Statements on Noise." Report of Working Group 69 of the Committee on Hearing, Bioacoustics, and Biomechanics, National Research Council.

Fig. 4.2.11. Predicted percent of persons highly annoyed by noise exposures, based on past studies near airports, busy streets, and railroads.

NOISEMAP is a computer model used to predict the noise environment for airbase/ airport type operations and can be used in modeling certain low altitude operations such as air to ground and air to air operations conducted in RAs and MOAs. ROUTEMAP can be used to describe these environments as well if specific flight patterns are defined for the operations.

The traditional noise-annoyance relationship contained in ROUTEMAP (Fig. 4.2.11) currently is used by the Air Force to predict the level of annoyance for low altitude operations. However, research conducted for the GEIS found no statistically significant relationship between noise as measured by L_{dnmr} and annoyance. Further, field data collected as part of the GEIS for the 11 case study sites indicate that actual levels of annoyance with aircraft noise on military training routes are, on average, 6.6 times greater than model predictions. GEIS surveys revealed that overall annoyance with low altitude flights, as measured by annoyance with one or more of the four annoyance variables (noise, presence, altitude, possibility of crash), is greater than annoyance with noise alone. Overall annoyance on military training routes averages 11.7 times greater than ROUTEMAP predictions. The range of annoyance (with one or more of the four annoyance variables) due to low altitude flying activities generally can be expected to be 25-40%.

The substantial disparity between GEIS findings and the predictions of ROUTEMAP suggests the need for further testing of ROUTEMAP under low altitude training airspaces. At the same time, exploration of other predictive metrics based on peak, rather than average, sound levels also might be worthwhile.

There are several possible reasons for the disparity between annoyance levels ROUTEMAP predicts and actual annoyance levels reported during face-to-face interviews conducted in the GEIS. The primary reason is that, as indicated earlier, GEIS research found no statistically significant relationship between L_{dnmr} and reported annoyance under low altitude training routes. One explanation for the lack of a correlation between L_{dnmr} and annoyance is that a noise measurement relying on an average value for intermittent flight activity may not represent adequately the nature and amount of noise experienced by people beneath the airspaces. Many physical factors including the distance between the aircraft and individual, topography, tree cover, type of structure, and ambient noise levels all introduce important variations in the noise environment affected by Air Force low altitude aircraft. On the other hand, the L_{dnmr} values computed by ROUTEMAP varied relatively little from airspace to airspace. Eight of the 11 airspaces fell within 50.2 and 53.5 decibels, and 10 of the airspaces were below the decibel value traditionally considered to produce significant community annoyance levels (65 decibels).

A second explanation is that the meaning people attribute to noise sources influences the degree to which people are affected by the source (as discussed in GEIS and other research). The point borne out by GEIS survey results is that, although low flying aircraft do make noise, aspects of the flying other than the noise level bother some people. For example, more people report annoyance with the possibility that a plane may crash than with the noise planes make. GEIS analyses examined a range of social factors, including support for flights, and found them to be more closely related to impacts than the flight parameters that are used to calculate L_{dnmr}. In addition, people may be ambivalent about the flights. They can by annoyed and still support the flights. So, annoyance alone is neither descriptive of the full extent of social impacts nor the context of social impacts.

Nevertheless, the GEIS survey results indicate that for most low altitude airspaces the annoyance level can be expected to be between 25 and 40 percent. Importantly, however, few people seem to be annoyed to the extent that they are compelled to seek redress through filing formal complaints, forming or participating in groups opposing low altitude flying, or any other actions. The most effective means of identifying and mitigating impacts may be to work closely with affected communities in developing and operating low altitude airspace. Through this cooperative process, particularly sensitive areas and facilities can be identified and avoided to the extent possible. In this way, the worst impacts can be avoided and the other adverse impacts often may be made more palatable. It may be that dealing with the public as important and active participants in the development and operation of low altitude airspaces will do much to make such activities more acceptable.

4.3 NOISE[5]

4.3.1 Summary of Findings

In the study of potential adverse effects from noise related to low altitude aircraft flights (Appendix C), many gaps were found in the existing relevant literature and scientific uncertainty was abundant. Implications for public health from a given exposure, such as the training flights, are typically based upon a characterization of risk, which is a synthesis of findings from risk assessment activities. However, hard and fast conclusions are often difficult to draw from such studies due to confounding variables, the need for assumptions, and the lack of clinical or experimental data.

Noise, one of the physical effects produced by low altitude flying, is widely recognized as a hazard to health that can lead to auditory and potentially to non-auditory effects (Moller 1977; Loevy and Roth 1968; Thompson 1981; and Kryter 1984). Because the noise levels associated with low altitude flights are not sustained and are not at

[5]This section summarizes the analyses included in the case studies section (Vol. III) and the noise assessment (Vol. IV, Appendix C).

sufficient levels to produce hearing loss in the population overflown, the role of noise in potential non-auditory effects became the more logical focus of research. The two most frequently identified non-auditory health effects associated with noise exposure are adverse reproductive outcomes (ARO) and cardiovascular disease (CVD).

These disease endpoints are of significant concern to the public and to scientists. Various researchers (Anticaglia 1970; Kryter 1972; Hartoon and Treuting 1981; and Neff 1982) have reported that chronic exposure to noise has the potential for disrupting normal fetal development. Similarly, the hypothesis that some risk of CVD may be due to noise exposure has been established in the literature (USEPA 1981). However, study of either of these diseases (ARO and CVD) is a complex undertaking because they are heavily confounded by a variety of risk factors of which noise is only one.

A number of animal studies are reported for both ARO and CVD, but they have limited usefulness in examining noise effects because they do not account for the subjective perceptions of sound by humans (as desired information, as intrusive on peace and quiet, as positive reinforcement, as stressful, etc.). Generally, the human studies have not adequately considered and controlled the many potential confounding factors (e.g., age, race, sex, life style factors, etc.). Perhaps, even more deficient has been the characterization of exposure reported in these studies (e.g., levels of noise, physical health of the study population, noise attenuation factors which may have been present, etc.). Most importantly, the prospective studies needed to determine temporal relationships between exposures and endpoints, thus allowing inferences about true causality, were not available.

Specifically with regard to the relationship between ARO and noise, the results of over 30 studies incorporating a variety of experimental conditions were inconsistent. However, based on the toxicologic and epidemiologic data reported in the literature, there is insufficient evidence to infer a significant risk to humans of birth defects or other adverse reproductive outcomes associated with levels of noise proximal to major airports and even less so for low altitude flying operations (Meyers et al. 1989).

Noise is one of the potential risk factors for CVD, as a chronic stressor from annoyance via both subjective responses to irritation (frustration, fear) and also psychological strain in the form of hormone stimulation (Kryter 1984). Cardiovascular disease, the leading cause of death in the United States, is a vital area for research. However, CVD can be affected by more risk factors than can be adequately considered in ecologic research and its diagnosis is complex. Accordingly for this GEIS study, hypertension an easily and accurately diagnosed risk factor for CVD was selected as a surrogate measure for exploring the CVD-noise association; such study was facilitated by a large number of noise studies which reported hypertension prelevance.

Hypertension is clearly in the casual pathway for CVD and offers biologic plausibility. In regard to noise exposure, it is biologically plausible that peripheral vasoconstriction may be an adaptive response to a stressor stimulus (Kryter 1984). Notably, hypertension is highly prevalent with over 30% of adults above 45 years of age having some degree of hypertension (U.S. Dept. of Commerce 1984). In addition to its role with CVD, hypertension is related to cerebrovascular disease, the nation's third leading cause of death. Noise exposure may promote additional stress and incrementally increase the risk of hypertension.

The objectives of the health effects research were to review the published literature and to summarize existing data in order to formulate a risk estimate of noise impacts on hypertension prevalence. Two strategies were utilized to provide complimentary estimates of the magnitude of risk. The first was a detailed review selecting a small number of the best designed and executed studies; the data from 3 studies was then combined in a Mantel-Haenszel procedure. The second strategy was to identify a number of studies which reported data in sufficient detail so that a meta-analysis could be performed. Although over 80 studies were considered, only 3 were selected for inclusion in the development of a summary risk measure using the Mantel-Haenszel analysis and 10 were selected for a meta analysis. The 3 studies incorporate ecologic, occupational epidemiologic research, each of which independently had established a point estimate of risk for hypertension due to noise exposure. Using a Mantel-Haenszel procedure with the data from the 3 studies, a pooled point estimate was calculated with weighing based on sample variance (related to sample size). The resultant summary risk estimate was 1.22 for a noise exposure of ≈85 dB L_{dn}, indicating a small increase in risk (i.e., 22% @85 L_{dn}). The level of 65 L_{dn} is considered to be a no effects level. The second analysis used explicit data from 10 studies combined in a meta-analysis. Risk levels derived in this process were slightly greater than the corresponding levels derived using the Mantel-Haenszel approach. These two different methods are used to provide the bounds of the noise risk for hypertension.

Risk factors for hypertension are many and complex. With regard to most of the noise levels identified in the case studies, those risk factors derived genetically or as a result of lifestyle are of far more consequence to increasing the risk of hypertension than is the factor of noise. Therefore much caution must be used in interpreting the summary risk estimate derived for exposure to aircraft noise. It is possible to infer a potential health effect at the higher noise levels, (e.g., >75 L_{dn}) but direct attribution (causality) may not be stated because hypertension has so many potentially contributing factors in addition to noise. For the majority of people overflown, the noise under low altitude airspace adds only a small increment to the recipient's overall noise exposure. Most of the low altitude training flights do not produce noise at a level greater than 65 dB and take place over very remotely populated areas. In addition calculated noise levels are usually for the highest exposure level in the airspace; the majority of people will never experience these levels either because they are at some distance from the heavily overflown areas or due to sound attenuation for persons in buildings. Noise levels decrease significantly with minor increases in altitude and lateral offset distances. Thus, only a small fraction of the entire population under a particular airspace will be exposed to the maximum levels of noise.

The application of these findings to the 12 GEIS case study airspaces gives an indication of the expected health impacts from noise for low altitude flying operations. The twelve cases reviewed in Vol. III involve a wide variety of aircraft, airspace designations, and ground level features. For the most part, low flying activities taking place at subsonic speeds are judged to be relatively benign in accordance with the health effects findings. Based on the sample of 12 case studies, one primary airspace and one concurrent use airspace might have a relative risk in excess of 1.0. It should be noted that these impact levels are calculated only for the highest level of noise exposure under the airspace; noise levels decline as distance from these areas increases. Thus, the entire population under the airspace is not exposed to impacts of these levels. A risk of 1.3 is calculated in one airspace because flying activity at the associated range is quite high; however, very few receptors are exposed to the noise. The risk of 1.18 for another airspace is due to a much more heavily used Navy route that is concurrent with the case study airspace. The case studies, however, principally involved noise level exposures of less than 65 L_{dnmr}. These levels are below the point at which the Department of Housing and Urban Development considers the noise level to be excessive for residences. Approximately 40 million Americans are exposed to levels above 65 dB as a result of noise in urban environments (EPA 1974). Interestingly, as many as 5 million persons in the U.S. urban population experience noise levels even greater than the noisiest airspace examined in the case studies.

Without question, all communities in the United States have a measurable prevalence of hypertension (a background rate). The original research intent in noise effects was to assess quantitatively if the risk of CVD increased incrementally due to increased noise exposure (a hypothesized but poorly understood relationship). Other than an extremely expensive prospective study (beyond the bounds of this effort) which would permit a direct measure of risk, the main alternative approach was by use of an information synthesis technique; two such methodologies were used. The results of the two philosophically different approaches were quite similar and point to small, but monotonically increasing relative risks of hypertension with increasing noise exposure.

On the whole, it can be concluded that noise from low flying subsonic training activities present a negligible threat to people. Selected locations, however, may incur some incremental health risk as a result of unusually high noise levels.

Of the 12 case studies, only one situation was identified in which the added noise levels from concurrent use airspace resulted in changing the impact intensity upward. Generally the overlap area is small relative to the primary airspace and the resulting overflown population will be small. Cases in which these increased cumulative impacts occur are frequent enough to warrant assessment. Therefore it is necessary that a thorough review of such possibilities be made when new airspace is proposed.

4.3.2 Classification of Impacts

Noise as an environmental exposure can affect a wide range of human concerns, as described in Sect. 4.2.1. Historically, for noise associated with transportation sources, these concerns have been evaluated through the medium of social surveys and laboratory studies. The most widely used predictor which integrates the spectrum of intrusiveness endpoints (e.g., sleep disturbance, speech interference, learning interference, etc.) has, in the past, been a measure of "highly annoyed" persons as a function of noise level, measured with the day-night level, L_{dn} (NAS 1977).

For the most part, the data on annoyance versus L_{dn} have been obtained under conditions of many noise events per day (i.e., near a major airport) up to nearly continuous (near a major highway) noise. These conditions are not present for most of the airspace under evaluation in this GEIS. The three major differing conditions are: (1) intermittent rather than continuous noise events, (2) more rapid noise onset (because of low altitude, high speed, flyovers), and (3) the considerable differences in social context between rural settings where the low altitude flyovers occur and urban settings where most of the previous noise-versus-annoyance data were obtained.

In an attempt to provide a penalty for the additional annoyance resulting from the startle effect of unanticipated, rapid onset events, the Air Force has developed a variant calculation for the L_{dn}. The "Interim Metric" penalizes the noise source up to 5 dB for rapid onset and low altitude, approximately doubling the energy level received by the observer. This metric, L_{dnmr}, is incorporated in the ROUTEMAP computer code which is used to calculate aircraft noise levels used in this document. The program uses operational parameters, including aircraft type, speed, engine power setting, altitude and number of daytime and nighttime sorties, to calculate L_{dnmr} noise levels on IR and VR military training routes. For this GEIS, the ROUTEMAP program was also used to calculate L_{dnmr} noise levels beneath SRs. To calculate L_{dnmr} noise exposure levels in MOAs and RAs, the airspaces were divided into sections and treated as a series of VRs with flights distributed throughout. To reflect existing conditions beneath each airspace, an ambient noise level of 50 dB (L_{dn}) is assumed, based on guidelines for rural areas with some human and mechanical activity (National Academy of Science, *Guidelines for Preparing an Environmental Impact Statement on Noise*, 1977). For purposes of comparison, a change in noise levels of less than 3 dB is barely detectable to the human ear.

Noise impacts include consideration of the traditional annoyance in terms of L_{dn} levels. Although not tested under most of the conditions present in low altitude air use, this relationship has proven to be useful in evaluating the human reaction to other noise sources including airports and highways (NAS 1977). Thus, the L_{dnmr} metric extrapolates the L_{dn} metric beyond the conditions for which it was developed. Work introduced in Sect. 4.2.1 has begun the process of evaluating annoyance and other responses to low altitude flights in the setting of sparsely populated rural areas. Sample size and noise measurement requirements in a very sparse population increase the difficulty in performing such studies.

Annoyance per se, while it is a reproducible measure around airports, highways, etc., is not sufficiently specific to allow the analyst to understand if there are or are not actual health impacts associated with exposure to low altitude flights; it does suggest a reduction in the quality of life or "well being" with increasing noise level.

In evaluating the literature (Appendix C), it is quite clear that noise is recognized as a hazard to health. The cumulative effects associated with occupational noise exposures are well established. Hearing loss is a primary occupational hazard associated with sustained noise exposure at relatively high levels. For most of the airspace used by the Air Force, noise levels are insufficient to produce hearing loss. However, even at noise levels below hearing loss thresholds, the role of noise as a stressor still is considered to entail potential risks to public health that requires scientific attention. Quantification of these risks, however, has been elusive (Thompson 1981). While cardiovascular disease and adverse reproductive outcome are not the only endpoints discussed in the literature, they are the better studied health outcomes.

Adverse reproductive outcome, as discussed in Appendix C, requires a rather prolonged exposure to quite high noise levels. Such conditions have not been found on the ground below low flying aircraft in any of the 12 case studies, nor are they anticipated. This risk, therefore, was eliminated from further consideration. On the other hand, the size of human populations which might be affected by an increase in noise level from low flying aircraft would be large for cardiovascular disease (CVD) due to a high prevalence rate and the large number of people exposed to aircraft on a national level. The existence of a CVD risk due to noise exposure was found to be a well established hypothesis in the literature (Thompson 1981). In spite of the numerous studies investigating the potential relationship between noise exposure and CVD, no serious attempt to review and summarize the data quantitatively has been made until the GEIS. Such an attempt is presented in Appendix C. On the basis of this work, impact measures are derived. Impacts are defined according to relative risk for hypertension, a major risk factor for CVD, particularly in persons at middle age and beyond. Table 4.3.1 presents these impact measures in predictive terms. The analysis in Appendix C suggests that noise exposure, in general, may be related to hypertension in that noise exposure may provide added stress to an already aggravated health condition. However, a perspective on the levels most often found in the 12 case studies can be obtained by comparing those levels i.e., 50 to 65 L_{dn} with common sources of exposure leading to similar L_{dn} levels. For example the exposure to an 80 dB kitchen garbage disposal 2 minutes per day leads to an L_{dn} of 53.8 and mowing 4 hours per month with a 90 dB lawnmower leads to an L_{dn} of 67.5. Thus exposures of similar duration and intensity are present in both household and low level airspace settings. The description of actual potential health consequences of such low exposure levels to intermittent noise awaits additional research.

Table 4.3.1. Levels of the risk factor for noise impacts on hypertension

Noise level L_{dn}	Scaled risk factors[1] Mantel-Haenszel	Meta-analysis	Average
75-79	1.15	1.41	1.30
70-74	1.10	1.26	1.18
65-69	1.05	1.15	1.10
≤65	1.00	1.08	1.04

[1]These relative risk measures derived by two methods, thus representing a range of values are the average of risks determined by two philosophically different methods (see Appendix C). They should not be considered highly accurate, rather they establish that the risk from exposure to noise is not zero and it increases with increasing noise level. The increasing levels suggest that proactive steps should be taken to minimize adverse responses. It may be recognized that annoyance (Fig. 4.2.11) precedes the health risk, and that, before a situation would become an important health risk, mitigation of the noise would have occurred due to other factors.

4.4 AMERICAN INDIANS[6]

4.4.1 Summary of Findings

In general, impacts to American Indians from low altitude flights are a result of Indians' perceptions of the flights. The resulting concerns are often derived from understandings of past events directly associated with the flights. Because the concerns must be assessed in terms of the tribal context, identification of the impacts requires on-site analysis of the specific situation. The GEIS determined that negative impacts arise

[6]This section summarizes the analyses included in the case studies section (Vol. III) and the American Indian assessment (Vol. IV, Appendix D).

from interference with: (1) tribal sovereignty, (2) religion and its contribution to cultural transmission, (3) tribal economy and subsistence activities, and (4) family quality of life.

Tribal sovereignty

Tribal sovereignty includes the ability of tribal governments and leaders to carry on governmental affairs among their people and advocate on behalf of their culture and people to non-Indian entities. Understanding sovereignty's importance is central to understanding impacts of low altitude flying on Indians. Indian tribal governments are established by treaty, legislation, and executive order. They have a legal relationship in accordance with Public Law 93-638, The Indian Self Determination Act of 1976, which confers upon tribal leaders a legitimacy to interact with other local, federal and state governments, credibility to speak for their own people, and the right to establish economic self sufficiency as a corporate entity. The procedures for maintaining the intergovernmental and interagency relationships necessary to carry on public affairs are often not well defined, and the instability of ongoing relationships can be a sensitive issue. When these relationships are not observed there is potential for conflict, and tribes may be compelled to undertake litigation and adversarial negotiation to insure their observance. Similarly, the legitimacy of tribal leadership of their own people may be undermined. Impacts of Air Force low altitude flying on Indian groups affected by the GEIS case study airspaces varied by the degree to which the Air Force involved tribal government in the airspace planning process.

An issue related to sovereignty is the Indian concern that their lands are subjected to an inordinate amount of low altitude flying operations. A comparison of geographic data for low altitude airspace in the continental U.S. and Alaska with the locations of Indian reservations indicates that the relative amounts of airspace over Indian and non-

Indian lands are essentially the same. As of 1981, there were a total of about 106,000 sq. miles of land on Indian reservations in the 48 coterminous states supporting approximately 736,000 individuals. A total of about 27,600 sq. miles, or 25% of all Indian land, was geographically located under Air Force low altitude airspace. This proportion compares favorably with the total land located under non-Indian airspaces in the United States, which amounts to about 906,400 sq. miles, or 25% of the United States, including Alaska or 30% of the coterminous 48 states. Military use of this airspace is limited to designated boundaries and varying scheduled hours of operation. The airspace above Indian reservations is part of the public domain, as is all other airspace, and comes within the administrative jurisdiction of the FAA rather than the individual tribes. Tribal grievances regarding airspace use have thus taken the form of nuisance complaints, and possible litigation of these complaints requires careful scrutiny on a case by case basis.

Religion and ceremonialism

In keeping with U.S. civil rights and Indian self-determination legislation, the American Indian Religious Freedom Act (AIRFA) was enacted to protect Indian religious practices and the opportunity to conduct them. Indian religious freedom is an indispensable component to the viability and continuity of Indian culture. Religion is a much more pervasive concept to Indians than non-Indians in that it is integrated into so many elements of Indian society. Religious practices may include (1) vision quests and other individual meditation which require solitude, quiet, and isolation from man-made noises; (2) larger ceremonies requiring the mobilization of family resources; (3) public celebrations following the ceremonies; (4) Native American Church prayer meetings; or (5) indoor Christian services.

Air Force flying activities may disrupt either the ceremony or the opportunity to conduct it through: (1) disrupting the conduct of a prayer or chant, thereby resulting in possible misdirection of sacred or supernatural power; and (2) indirectly interfering with access to a sacred location, or damaging the religious viability of sacred locations. Disruptions may vary in severity from interruptions which may require restarting a prayer or chant, to interruptions requiring the remobilization of kin members and resources to restart a ceremony at another time, and to interruptions which may irrevocably stop a once in a lifetime ceremony. Desecration of sacred locations may vary from noise or sight intrusion which violate the solitude of prayers, to intrusions which are seen as driving away holy people residing at sites. Most of the GEIS case study airspaces avoided Indian land boundaries. One MTR was assessed to have serious concerns with intensified ceremonial activities associated with reburial.

Tribal economy and subsistence

Many tribes have attempted to assert a degree of economic self determination through the corporate development of various economic ventures such as agribusiness, fisheries, forestry, tourism and other forms of recreation. These activities are considered as integral parts of the tribe's and its members' existence, and concerns have been expressed over interference with these ventures by low flying aircraft.

Subsistence activities are important in helping extended families protect individuals from complete poverty and dependency on welfare. They are also, along with religion, indispensable to cultural continuity between generations. Subsistence activities include hunting, gathering, agriculture and herding. Resources may include wild plants such as willows; pinon nuts; small and large game; livestock; and domestic plants such as corn, squash and melons. At the least, severity of impacts from Air Force activities range from making access or use of resources more difficult, as in spoiling a hunt by frightening game, scattering of livestock, to disrupting family peace and solitude during gathering or harvesting. If these disruptions are severe enough, tribal leaders and family spokespersons are compelled to raise concerns about the ability of various kin groups to continue subsistence activities. For example, game could change migratory paths, resulting in further expenditure of energy and resources which would place the families at an economic disadvantage. In other cases, access to resources could be stopped altogether. The probability of disrupting tribal economy and family based subsistence activities for the 12 case study airspaces was assessed to be low.

Family quality of life

To a far greater degree than mainstream society, Indian communities are organized around kinship and family systems which themselves are different from those found in the rest of America. Low altitude flights may become a threat to the peace of mind, particularly of the elderly, to such a degree that other family and tribal individuals are compelled to take action on their behalf. Such conditions could arise if apprehension is increased because of the association of training flights with warfare and forced resettlement, or if there is apprehension about startle effects and property damage caused by noise. Because of historical circumstances in which Indians have been willfully or negligently misinformed, and in which they have been forcibly resettled without just compensation or due process, their inferences from observed intrusions or noise will differ from those of people in mainstream America. The sensitivity to these risks and inconveniences is heightened if Indians perceive that they are bearing an inordinate share of the risk and inconvenience or if they are particularly vulnerable to the disruptions. Tribal groups interviewed at the four case study sites impacted by low altitude flying expressed varying concern about impacts to quality of life. People located in densely populated areas and the elderly were particularly sensitive.

Cumulative impacts

No concurrent airspace routes were noted for Indian reservations selected for case study assessment. Because reservations other than those selected for assessment are located under concurrent routes, it is possible to estimate the cumulative effects by considering what would happen if the probability of an event increased as a result of increased numbers of flights. In general, if the impacts on religion, economic and subsistence activities, and family quality of life are known to occur but are low because of the low probability of their occurrence, increased numbers of flights may result in a threshold at which the impacts shift to a higher level. At this threshold, impacts to sovereignty will become severe because tribal governments will be singled out increasingly by their constituencies to intervene in an intergovernmental capacity. As a result further requirements will be placed on the Air Force to plan carefully with the Indian Tribes in order to insure that timing, route selection, and altitude do not increase the likelihood of disruptions, or leave tribal governments out of the assessment, planning, and decision processes which allow them to advocate effectively on behalf of their people.

4.4.2 Classification of Impacts

As a result of GEIS scoping, literature reviews, and case studies of affected Indian cultures, four potential impacts of special concern to Indians have been identified. These include sovereignty, religion and ceremonialism, tribal economy and subsistence activities, and family quality of life. Future site specific assessments of military airspace proposals should focus on these areas. Table 4.4.1 classifies varying levels of impacts as they relate to American Indians. The matrix was developed to incorporate intensity of impact (general frequency of disruption) and an understanding of the impact context (relative importance of the event/activity to the social unit). It is important to visit

Table 4.4.1. Definition of Impacts for American Indians*

	Definition of impact			
Impact type	Negligible	Low	Moderate	High
Political and economic sovereignty	Impacts to the tribe's governmental legitimacy, political credibility, and corporate/economic viability are not indicated as a problem by tribal officials or elders	Temporary impacts to the tribe's governmental legitimacy, political credibility, and corporate/economic viability are indicated, but no immediate impacts are anticipated by tribal officials	Reversible impacts to tribe's governmental legitimacy, political credibility, and corporate/economic viability are indicated by tribal officials	Irreversible impacts to tribe's governmental legitimacy, political credibility, and corporate/economic viability are indicated (e.g., loss of a court case involving land or resource use rights dispute)
Religion and ceremonialism	Disruption of ceremony and access to sacred sites but no adverse religious effects indicated by tribal officials or elders	Ceremonial disruption and interrupted access to sacred sites, involving immediately reversible adverse religious effects (e.g., having to restart a chant or part of a chant during a ceremony or prayer meeting) reported by tribal officials or elders	Temporary disruption of ceremony and access to sacred sites, involving reversible adverse effects requiring remobilization of kin group and resources (e.g., having to restart a ceremony at another time) reported by tribal officials or elders	Permanent ceremonial disruption and loss of access to sacred sites, involving irreversible adverse religious effects (e.g. departure of holy people from sacred site or non-continuance of healing ceremony) reported by tribal officials or elders
Economy and subsistence	No interference with availability of or access to resources (e.g., willows, pinon nuts, game, land for livestock) indicated by tribal officials or elders	Potential of diminished access to one or more resources for less than the entire or tenure harvesting season or term (e.g. seasonal hunt or livestock transhumance season) indicated by tribal officials or elders	Potential of diminished access to one or more resources for an entire harvesting or tenure season (i.e., disrupting the seasonal or yearly cycle significantly) indicated by tribal officials or elders	Potential of diminished access to one or more resources for more than an entire harvesting or tenure season (i.e., impairing the ability to take part in seasonal or yearly cycles altogether) indicated by tribal officials or elders
Family quality of life	No evidence of adverse effect on families	Family spokespersons or tribal officials anticipate risk to families or groups within families but indicate no immediate impact	Family spokespersons or tribal officials anticipate risk and adverse impacts to families, but impact is short term and reversible	Family spokespersons or tribal officials anticipate permanent risk and adverse impacts to families

*The level of adverse impacts to American Indians is affected by the amount of interaction between the Air Force and Indian tribes in developing and operating the airspace. Failure to consult with affected tribes and their leaders not only hinders identification of sensitive resources and mitigation of impacts but may alienate Indians and thereby increase the level of impacts, particularly in respect to tribal sovereignty.

American Indian reservations under proposed low altitude airspace and hold discussions with tribal leadership and elders to judge the potential impacts highlighted in the matrix. A brief description of each impact is discussed below.

Sovereignty

Tribal governments are afforded special status with respect to the federal government. The ability of tribal leaders to deal with complaints about flights and be involved in the decision processes associated with airspace planning may influence their effectiveness as leaders. Although low altitude flying activity does not represent a direct challenge to tribal sovereignty the absence of informative discussion and feedback sessions between Air Force and Indian representatives may undermine the political credibility of tribal leaders.

Religion and ceremonialism

Low altitude flights are potentially problematic with respect to traditional ceremonialism, although not with Christian or Native American Church activities. Many traditional ceremonies are held out-of-doors and involve meditation. Flights may intrude aurally or visually on meditation such as vision quests which require solitude and isolation from manmade noises. Impacts are more serious to ceremonies that require acquisition of resources and the mobilization of large numbers of kin. In cases of once in a lifetime ceremonies, interruption may result in irrevocable cancellation. Flights may also cause minor disruptions of large public celebrations that follow ceremonies.

Economy and subsistence

Low altitude flights have potential for adverse impact on the subsistence activities of American Indian families. These activities include gathering locally available resources, hunting, agriculture and herding and dependence on recreational revenues. Low altitude flights may affect subsistence by increasing the expenditure of energy required to herd or hunt when animals are frightened, and making gathering more difficult by interrupting the solitude and interaction of the family while engaged in this activity. Economic resources of high use recreational areas on Indian land may be impacted by certain low altitude flying operations.

Family quality of life

Flights may cause Indian families' quality of life to be degraded if aircraft disrupt the solitude of the family, especially by causing stress to the elderly, or by affecting family lifestyles. These concerns may be aggravated by perceptions that the military is withholding information and that flights are conducted unnecessarily over Indian villages or households. As with tribal sovereignty impacts, these can be alleviated by conducting discussions with tribal leadership early in the assessment process.

4.5 STRUCTURES[7]

4.5.1 Summary of Findings

Effects of aircraft subsonic overflights on structures were investigated using a combination of theoretical models and experimental evidence. Damage potential is

[7]This section summarizes the analyses included in the case studies section (Vol. III) and the structures assessment (Vol. IV, Appendix E).

described a combination of statistical models that predict the magnitude of structural response to acoustic excitation and the damage threshold of conventional and unconventional structures. Acoustic excitation arises from three sources: (1) aircraft engine noise as measured under standardized conditions in 1/3 octave band levels at frequencies from 50 to 10,000 Hz; (2) the lift pulse pressure field which is a momentary pressure increase on the ground due to the downward reaction on the ground from the upward lifting force of the airflow over the aircraft wings; and (3) aircraft wake and trailing vortex pressure fields.

Data on aircraft engine noise are available from NOISEFILE within the Air Force's aircraft noise computer program, NOISEMAP. The reference noise spectra are specified in terms of one-third octave band levels at frequencies from 50 to 10,000 Hz at a standard distance of 1,000 ft and standard weather conditions of 59°F and 70% RH.

The lift pulse is proportional to the aircraft weight and inversely proportional to the square of the distance from the receptor structure. Since this pressure field is directly proportional to the aircraft gross weight, a C-5A traveling at cruise power at 200 ft AGL directly over a structure provides a maximum pulse effect of 3.3 lb/ft^2 for all U.S. aircraft. By comparison, buildings are often designed for wind gust loads of at least 20 lb/ft^2.

The other sources of dynamic pressures on a structure is due to aerodynamic noise generated by the wake and trailing vortices shed by the airflow over the aircraft. This "airframe noise" has been studied extensively in the process of defining a lower limit on aircraft noise close to airports. In addition, low frequency data are available from controlled and uncontrolled low altitude flyover tests of military jet aircraft. By modeling this data, an equation has been derived (Appendix E) which relates the low frequency (below 50 Hz) airframe noise level to the aircraft speed, wing area, and slant range distance. These free field expressions for noise levels are then modified to include effects due to the presence of structures and to provide a time history of acoustic loading.

The response of structures to the broad band noise produced by aircraft propulsion systems and airframe passage through the atmosphere is defined by using analytic models for vibratory deformation response of a structure to acoustic excitation and the resulting stress response of the structure to this deformation. Experimental data on response of structures to acoustic excitation provides critical support to the analytical models in several key areas. Acceleration response of structures is driven by steady state noise to help define multi-modal responses, and values for the dynamic magnification for structures. Vibration responses of structures to blast or sonic boom are used to help define typical resonance frequencies and damping. Composite probability of damage (POD) is then calculated.

4.5.1.1 *Summary of calculation for probability of damage*

Potential damage effects were examined for a variety of structures commonly encountered in low altitude flying activities. Four broad categories were selected for analysis. These categories cover the full range of structure types identified in the GEIS public hearings (U.S. Air Force 1987) as well as a logical extension to all types of structures that could be located in significant numbers under low altitude flying activities. These four categories and the specific types of structure in each category are listed in Table 4.5.1. For each of the types of structures, a damage threshold stress was estimated on the basis of materials properties as well as results from actual breaking tests.

Table 4.5.1. Types of structures included in generic assessment of potential damage to structures from MTR flight activity

Major category	Subcategory	
Occupied buildings	Wood frame	Gypsum wallboard interior
	Wood frame	Plaster interior
	Wood frame	Wood panel interior
	Masonry	Building stone
	Masonry	Brick
	Masonry	Adobe
	Metal frame	
	Windows	5 size categories from 1 to >100 ft^2
Unoccupied buildings (maintained)[1]	Wood frame	Plastic interior
	Wood frame	Wood panels
	Masonry	Building stone
	Masonry	Adobe
	Windows	One size category, 2-10 ft^2
Prehistoric/archaeological buildings	Masonry (stone)	Roof intact
	Masonry (stone)	No roof
	Adobe	Roof intact
	Adobe	No roof
Seismically sensitive	Water tanks	
	Early American petroglyphs/caves	
	Avalanches	Loose snow
	Avalanches	Slab
	Landslides	

[1]Generally more than 50 to 100 years old but maintained in reasonable good condition.

The net result of applying this calculation process is shown in Table 4.5.2 for the B-1B aircraft flying on a MTR track at an altitude of 200 ft. AGL. (This aircraft was

Table 4.5.2. Statistical evaluation of potential structural damage from MTR flights

Aircraft type = B-1B
Speed, kts. = 540

TYPE OF STRUCTURE	Sideline, ft. = 0; Altitude, ft. = 200: Composite PODo (1)	Max. PODt (2)	Ratio Comp'ste to Max. (3)	Sideline 3300; Altitude 200: Composite PODo	Ratio Comp'ste to Max.	Sideline 6600; Altitude 200: Composite PODo	Ratio Comp'ste to Max.	Sideline 9900; Altitude 200: Composite PODo	Ratio Comp'ste to Max.	Sideline 13200; Altitude 200: Composite PODo	Ratio Comp ste to Max.
OCCUPIED BUILDINGS											
WOOD FRAME-GYPSUM BOARD	5.1E-05	2.0E-03	0.026	4.6E-05	0.023	3.2E-05	0.016	1.7E-05	0.009	7.2E-06	0.004
PLASTER WALLS/CEILING	4.9E-06	2.4E-04	0.020	4.6E-06	0.019	3.3E-06	0.014	1.8E-06	0.007	7.8E-07	0.003
WOOD WALLS (BARNS)	1.7E-07	8.3E-06	0.020	1.6E-07	0.019	1.1E-07	0.014	6.2E-08	0.007	2.7E-08	0.003
MASONRY-STONE	1.8E-13	9.0E-12	0.020	1.9E-13	0.021	1.4E-13	0.016	8.4E-14	0.009	3.8E-14	0.004
CONCRETE BLOCK	4.5E-11	2.2E-09	0.020	4.5E-11	0.020	3.4E-11	0.015	1.9E-11	0.008	8.5E-12	0.004
BRICK	3.4E-07	1.7E-05	0.020	3.2E-07	0.019	2.3E-07	0.014	1.2E-07	0.007	5.3E-08	0.003
ADOBE WALLS	1.0E-09	5.0E-08	0.020	9.6E-10	0.019	7.1E-10	0.014	3.9E-10	0.008	1.7E-10	0.003
METAL BUILDING WALLS	3.7E-08	1.8E-06	0.020	3.4E-08	0.019	2.5E-08	0.014	1.4E-08	0.007	5.8E-09	0.003
WINDOWS,TYPE A, 1-2 ft²	2.8E-05	1.3E-03	0.021	2.5E-05	0.019	1.8E-05	0.014	9.6E-06	0.007	4.1E-06	0.003
TYPE B, 2-10 ft²	1.2E-05	5.5E-04	0.021	1.1E-05	0.019	7.5E-06	0.014	4.1E-06	0.007	1.7E-06	0.003
TYPE C,10-50 ft²	3.0E-05	1.4E-03	0.022	2.7E-05	0.019	1.9E-05	0.014	1.0E-05	0.007	4.3E-06	0.003
TYPE D,50-100ft²	2.2E-04	9.4E-03	0.024	2.0E-04	0.021	1.4E-04	0.015	7.5E-05	0.008	3.1E-05	0.003
TYPE E, =>100ft²	2.5E-04	1.1E-02	0.023	2.2E-04	0.021	1.5E-04	0.014	8.3E-05	0.008	3.0E-05	0.003
UNOCCUPIED BUILDINGS (4)											
WOOD FRAME - PLASTER	3.5E-05	1.7E-03	0.021	3.2E-05	0.019	2.3E-05	0.013	1.2E-05	0.007	5.3E-06	0.003
WOOD FRAME-WOOD PANELS	1.4E-06	6.5E-05	0.021	1.2E-06	0.019	8.8E-07	0.014	4.8E-07	0.007	2.0E-07	0.003
MASONRY	9.9E-12	4.9E-10	0.020	1.0E-11	0.020	7.6E-12	0.015	4.3E-12	0.009	1.9E-12	0.004
ADOBE	2.2E-07	1.1E-05	0.020	2.0E-07	0.019	1.4E-07	0.014	7.9E-08	0.007	3.4E-08	0.003
WINDOWS, TYPE B	4.3E-05	2.0E-03	0.022	3.9E-05	0.020	2.7E-05	0.014	1.5E-05	0.007	6.2E-06	0.003
PRE-HIST./ARCHEO. SITES											
MASONRY/STONE-ROOF OK	4.3E-05	2.0E-03	0.022	3.9E-05	0.020	2.7E-05	0.014	1.5E-05	0.008	6.2E-06	0.003
MASONRY/STONE-NO ROOF	6.6E-06	3.1E-04	0.021	6.0E-06	0.019	4.2E-06	0.014	2.3E-06	0.007	9.7E-07	0.003
ADOBE - ROOF OK	7.1E-06	3.3E-04	0.021	6.4E-06	0.019	4.5E-06	0.014	2.5E-06	0.007	1.0E-06	0.003
ADOBE - NO ROOF	8.0E-07	3.9E-05	0.021	7.3E-07	0.019	5.2E-07	0.013	2.8E-07	0.007	1.2E-07	0.003
SEISMIC'LY-SENSITIVE AREA											
WATER WELLS/TANKS	1.6E-07	7.7E-06	0.021	1.5E-07	0.019	1.0E-07	0.014	5.7E-08	0.007	2.4E-08	0.003
EARLY AM.PETROG./CAVES	6.8E-08	3.2E-06	0.021	6.2E-08	0.019	4.4E-08	0.014	2.4E-08	0.007	1.0E-08	0.003
AVALANCHES- LOOSE SNOW	6.4E-06	3.1E-04	0.021	5.9E-06	0.019	4.2E-06	0.013	2.3E-06	0.007	9.7E-07	0.003
AVALANCHES- SLAB	8.4E-09	4.1E-07	0.020	7.8E-09	0.019	5.6E-09	0.014	3.1E-09	0.008	1.3E-09	0.003
LANDSLIDE AREAS	7.2E-18	3.6E-16	0.020	7.9E-18	0.022	6.5E-18	0.018	3.8E-18	0.011	1.8E-18	0.005

(1) PODo = Composite probability of structural damage from one MTR flight for structure located at specified sideline distance from track centerline including consideration of statistical dispersion of aircraft flight track about this centerline.

(2) PODt = Maximum probability of damage for one MTR flight directly over structure at specified altitude.

(3) Ratio of Composite (PODo) to Maximum (PODt) Probability of Damage.

(4) Historic buildings maintained in reasonable repair.

selected for illustration here since it represents the worst case for jet aircraft.) The column to the right of the list of structure types defines the composite probability of damage (POD_o) for a structure at a sideline position of 0 (i.e., directly under the nominal MTR centerline) for one B-1B MTR flight anywhere on the MTR route. The column next to that is the maximum value of POD_o if the aircraft flew only directly overhead, and the column after that is the ratio of these two probabilities. The remaining columns list the paired values of the composite POD_o and the ratio of this composite value to the reference maximum value (aircraft directly overhead) for the four other sideline positions of a structure (3,300, 6,600, 9,900 and 13,200 ft or 0.5, 1, 1.5 and 2 times the standard deviation of the flight track dispersion [1.25 miles]).

Note that there is very little change in the composite POD_o until the sideline position is more than 3,300 ft off the centerline (i.e., greater than one-half standard deviation of flight track dispersion). This simply reflects the influence of the relatively wide dispersion in the MTR flight tracks. Figure 4.5.1 illustrates this point more clearly in terms of the composite POD_o for several selected structures as a function of sideline position of the structure.

Appendix E contains a complete listing of tables, similar to Table 4.5.2, for all MTR jet aircraft. In addition, Appendix E contains a simplified table summarizing the composite POD_o for all of the helicopters but only for structures located directly under the nominal MTR center line. While the values of POD_o are higher than for jet aircraft due to the higher levels of low frequency sound for helicopters, the POD_o values will drop off more rapidly with distance due to the estimated smaller track dispersion (i.e., 6,600/4 or 1,650 ft) assumed for helicopters. This drop-off in POD_o for helicopters would, in fact, be expected to have a pattern similar to that shown in Fig. 4.5.1 but with sideline distances divided by four to account for an anticipated greater accuracy of flying along routes.

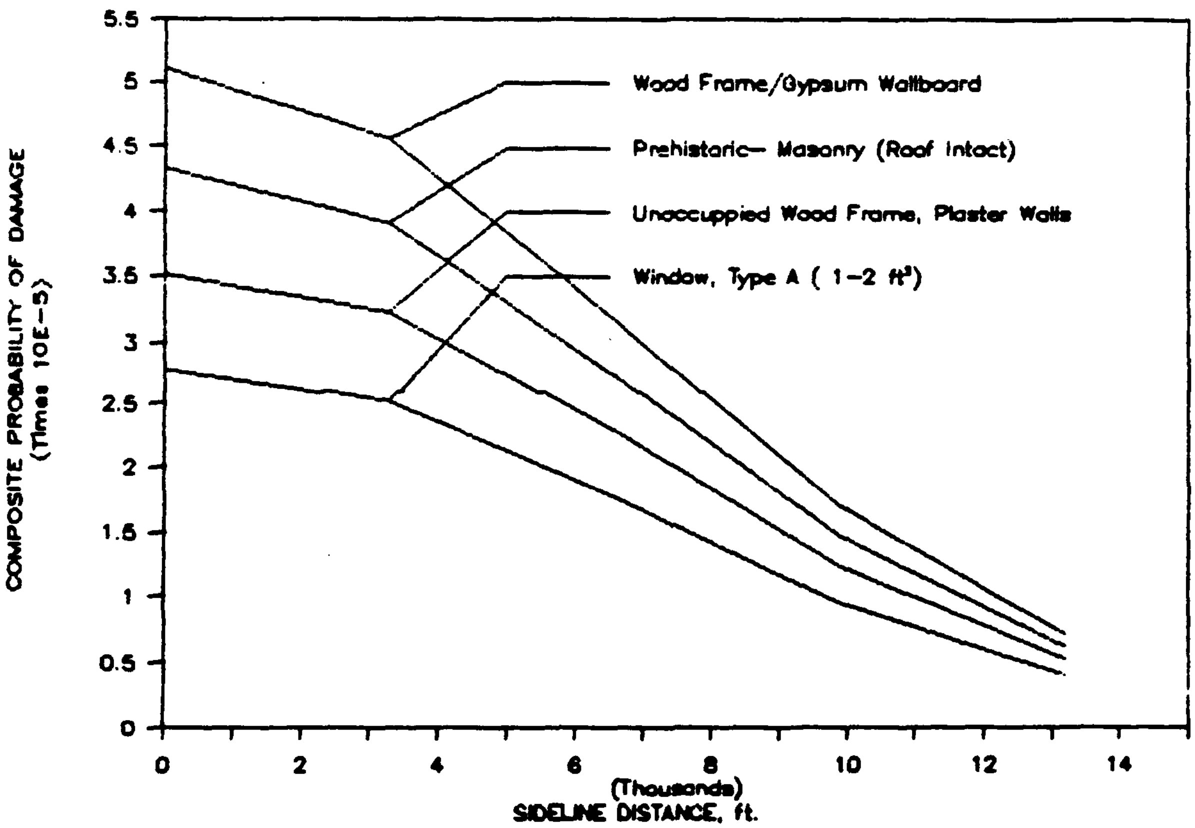


Fig. 4.5.1. Change in composite probability of damage versus sideline position of structure for four representative structures under a B-1B MTR flight at 200 ft altitude.

An indication of how the estimated damage probabilities will change if the aircraft operate at higher altitudes is provided in Table 4.5.3 and Fig. 4.5.2. This table lists the composite POD_o for each one of the selected structures for a B-1B bomber flying at 200 ft and at 400 ft, and the ratio of these values of POD_o (i.e., POD_o [400 ft]/POD_o [200 ft]). The same type of information also is given for a CH-54B helicopter flying at 50 ft and 200 ft. In both cases, the structure is directly under the nominal track centerline at 0 sideline distance. The change in POD_o as altitude is increased is relatively small for the higher values of the probability of damage POD_o but decreases rapidly with altitude for smaller POD_o values. In other words, *for those types of structures most susceptible to damage from MTR overflights, increasing the aircraft altitude by two to four times does not necessarily result in a large decrease in composite damage probability*, but for structures not as likely to be damaged (i.e., low value of POD_o at low altitudes), increasing the aircraft altitude causes a marked further decrease in damage probability. This pattern is illustrated more clearly in Fig. 4.5.2 which shows the change in the ratio of POD_o at 40 ft to the value at 200 ft for a B-1B aircraft as a function of the composite POD_o at 200 ft for all of the various structural types evaluated in Table 4.5.3.

(Note that Table 4.5.3 indicates that for the CH-54B helicopter, the *composite* probability of damage POD_o for a flight at 200 ft AGL is actually higher, in a few cases, than the *composite* probability at 50 ft AGL where the latter (POD_o at 50 ft) is greater than about 2 percent. This can be attributed to the lower lateral attenuation for the higher altitude.)

The behavior in Fig. 4.5.2 is due to the relatively large standard deviation of the factor of safety so that the smaller the initial value of POD_o (or the farther the initial value is along the probability distribution curve of the factor of safety) the greater the

Table 4.5.3. Comparison of composite probability of damage from aircraft flying on MTR at two different altitudes

	JET AIRCRAFT			HELICOPTER		
	Aircraft type =		B-1B	Helicopter type =		CH-54B
	Speed, kts, =		80	Speed, kts, =		80
	Sideline, ft. =		0	Sideline, ft. =		0
TYPE OF STRUCTURE	Composite 200 ft. -	PODo @: 400 ft. -	Ratio of PODo @ 400' PODo @ 200'	Composite 50 ft. -	PODo @: 200 ft. -	Ratio of PODo @ 200' PODo @ 50'
OCCUPIED BUILDINGS						
WOOD FRAME-GYPSUM BOARD	5.1E-05	4.2E-05	0.83	2.2E-02	4.65E-02	2.09
PLASTER WALLS/CEILING	4.9E-06	5.6E-07	0.11	5.2E-02	7.57E-02	1.45
WOOD WALLS (BARNS)	1.7E-07	2.3E-08	0.14	8.2E-03	4.54E-03	0.55
MASONRY-STONE	1.8E-13	2.5E-15	0.01	8.3E-05	1.19E-06	0.01
CONCRETE BLOCK	4.5E-11	1.3E-12	0.03	6.1E-04	4.33E-05	0.07
BRICK	3.4E-07	4.6E-08	0.14	1.2E-02	7.22E-03	0.59
ADOBE WALLS	1.0E-09	6.3E-11	0.06	1.2E-03	1.87E-04	0.15
METAL BUILDING WALLS	3.7E-08	5.0E-09	0.14	3.3E-03	1.28E-03	0.38
WINDOWS, TYPE A, 1-2 ft^2	2.8E-05	1.0E-05	0.37	3.2E-07	1.61E-09	0.00
TYPE B, 2-10 ft^2	1.2E-05	3.6E-06	0.31	2.6E-05	6.62E-07	0.03
TYPE C, 10-50 ft^2	3.0E-05	1.1E-05	0.37	4.5E-02	8.68E-02	1.92
TYPE D, 50-100 ft^2	2.2E-04	1.6E-04	0.70	9.8E-02	2.79E-01	2.84
TYPE E, =)100 ft^2	2.5E-04	1.4E-04	0.59	9.5E-02	2.69E-01	2.82
UNOCCUPIED BUILDINGS (10)						
WOOD FRAME - PLASTER	3.5E-05	6.5E-06	0.18	8.8E-02	1.83E-01	2.09
WOOD FRAME-WOOD PANELS	1.4E-06	3.4E-07	0.25	1.2E-02	1.05E-02	0.84
MASONRY	9.9E-12	2.2E-13	0.02	3.8E-04	1.84E-05	0.05
ADOBE	2.2E-07	2.9E-08	0.13	9.9E-03	5.93E-03	0.59
WINDOWS, TYPE B	4.3E-05	1.7E-05	0.40	5.1E-02	1.06E-01	2.08
PRE-HIST./ARCHEO. SITES						
MASONRY/STONE-ROOF OK	4.3E-05	2.0E-05	0.46	4.5E-02	9.25E-02	2.07
MASONRY/STONE-NO ROOF	6.6E-06	2.2E-06	0.33	2.2E-02	2.91E-02	1.30
ADOBE - ROOF OK	7.1E-06	2.3E-06	0.32	2.4E-02	3.16E-02	1.33
ADOBE - NO ROOF	8.0E-07	1.8E-07	0.22	1.0E-02	7.61E-03	0.73
SEISMIC'LY-SENSITIVE AREAS						
WATER WELLS/TANKS	1.6E-07	3.1E-08	0.20	4.7E-03	2.66E-03	0.57
EARLY AM. PETROG./CAVES	6.8E-08	1.8E-08	0.26	1.6E-03	8.19E-04	0.51
AVALANCHES- LOOSE SNOW	6.4E-06	1.4E-06	0.22	3.3E-02	4.62E-02	1.39
AVALANCHES- SLAB	8.4E-09	1.1E-09	0.13	1.4E-03	3.89E-04	0.28
LANDSLIDE AREAS	2.2E-21	7.6E-24	0.00	3.2E-07	5.17E-10	0.00

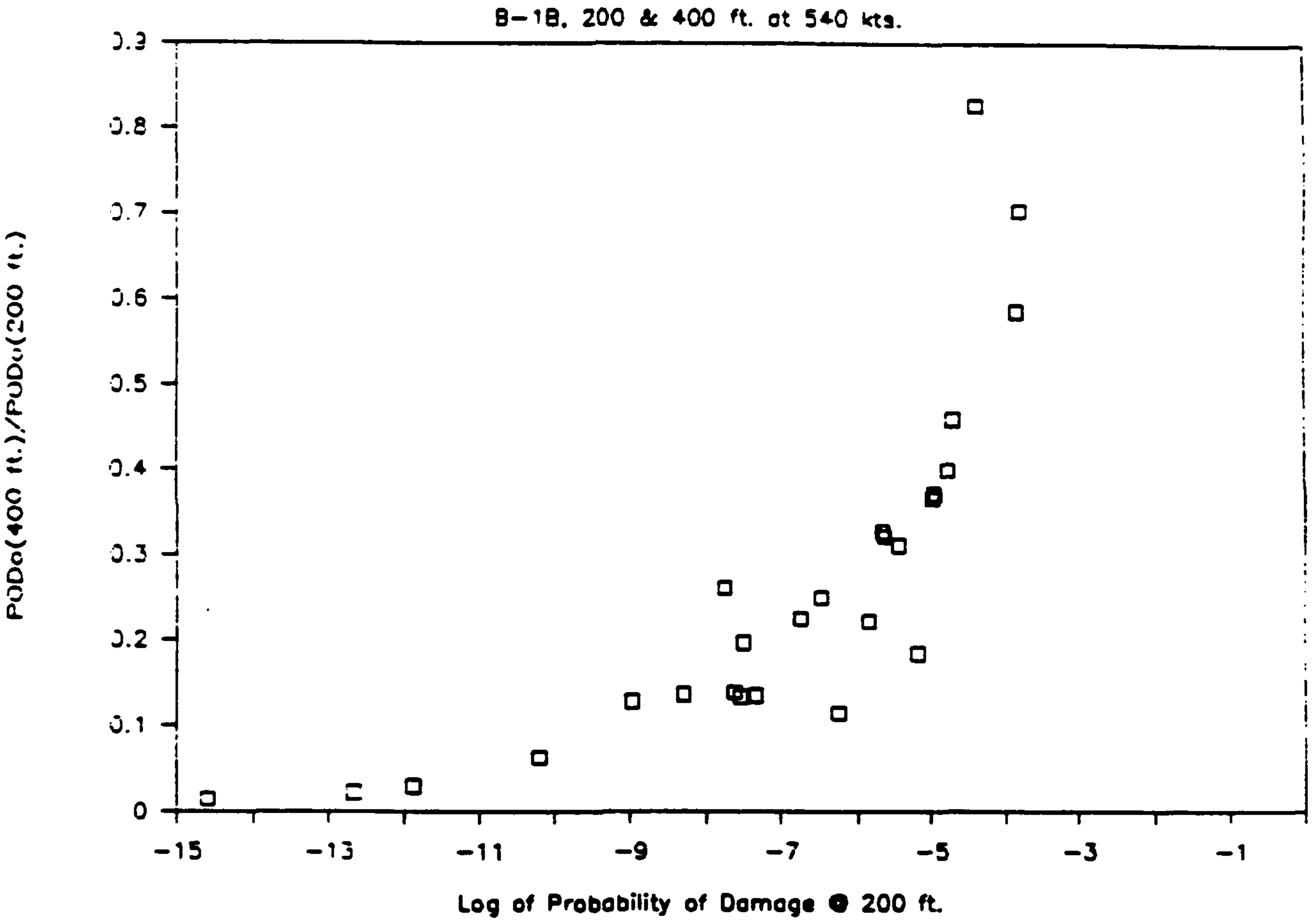


Fig. 4.5.2. Ratio of the composite probability of damage for B-1B at 400 ft altitude [$POD_a(400)$] to value [$POD_a(200)$] at 200 ft altitude.

additional decrease in POD_o for any decrease in noise level due to an increase in altitude.

4.5.1.2 *Evaluation of potential impacts*

An evaluation of potential impact on structures under any specific airspace can be made by following the steps outlined in Appendix E. This requires having detailed information on the type, number, and geographic distribution of the structures relative to the nominal centerline of an airspace under consideration. While such a detailed evaluation is not practical for every application, it is possible to provide a qualitative indication of the potential impact for a few typical or generic types of land which may be overflown by aircraft. The four types of land use selected for purposes of this study are:

1. Rural land with typical residential farmhouses and other miscellaneous utility buildings such as small stores, barns, etc.
2. National historical parks or sites containing various types of historical structures normally not inhabited but maintained in reasonably good repair.
3. Prehistoric sites of early American structures, caves, petroglyphs, etc.
4. Mountainous terrain subject to landslides in the absence of snow cover or avalanches for snow-covered slopes.

For this summary, it will be assumed that an MTR (considered to be a worst case airspace for structures because flights are concentrated within a prescribed area) passes through each of these types of land and the route has an average of 4,000 sorties a year (URS 1989) of either one of the two categories of aircraft determined to have the highest potential impact—bombers and heavy helicopters. Other aircraft do not have the potential to cause structural impacts.

The results of this evaluation are shown in Table 4.5.4. Each type of structure is listed within one of the four general types of land use identified above. For convenience, they are listed in descending order of the operations-weighted composite probability of damage for bomber operations. For simplicity and to reflect a conservative estimate of the relative accuracy of the overall damage probability predictions, these figures are usually shown in the table to only one significant figure.

Bomber operations

Consider, first, the results under the column for bomber operations. For the first general land use category—rural areas—large windows with areas greater than 50 ft^2 are clearly the most susceptible to damage with values for POD of 0.3 to 0.4. This corresponds to a 30 to 40% probability of damage occurring to any one window of this type that lies within an effective damage zone extending out to $\pm$ 1.25 times the standard deviation of the track dispersion or (1.25 × 1.25 mile) ~$\pm$ 1.5 miles on either side of the MTR track. While there would be a finite probability of damage occurring for such windows outside this effective damage zone, this approximation is suitable at this point for purposes of relative impact on various types of structure.

For the remaining types of windows and for gypsum wallboard interior walls on wood-frame buildings, the probability of damage decreases to values in the range of 1 to 10% for each such structure lying within about 1.5 miles of the airspace centerline for one year of 4,000 operations. Plaster interior walls, brick buildings, barns, and water tanks are estimated to have less than a 1% probability of damage for each such structure.

Finally, for the most damage resistant types of structure, adobe, concrete, and stone masonry buildings, the estimated probability of damage is extremely small—on the order

Table 4.5.4. Probability of structural damage from bomber aircraft* and heavy helicopters along MTR TRACKS**

TYPE OF STRUCTURE	BOMBERS Alt. = 200 ft. POD nj (1)	HEAVY HEL'CPTRS Alt. = 50 ft. POD nj (2)
RURAL AREAS		
WINDOWS, TYPE E, =>100sq. ft.	0.4	3.2
"" TYPE D, 50-100 sq. ft.	0.3	3.3
WOOD FRAME-GYPSUM BOARD	0.08	0.7
WINDOWS, TYPE C, 10-50 sq. ft.	0.04	1.3
"" TYPE A, 1-2 sq. ft.	0.03	3E-04
"" TYPE B, 2-10 sq. ft.	0.01	8E-05
PLASTER WALLS/CEILING	0.005	1.3
BRICK	4E-04	0.2
WOOD WALLS (BARNS)	2E-04	0.1
WATER WELLS/TANKS	2E-04	0.2
METAL BUILDING WALLS	4E-05	0.1
ADOBE WALLS	1E-06	0.01
CONCRETE BLOCK	5E-08	0.005
MASONRY-STONE	2E-10	3E-04
HISTORIC SITES		
WINDOWS, TYPE B	0.06	1.5
WOOD FRAME - PLASTER	0.04	2.6
- WOOD PANELS	0.002	0.3
ADOBE	2E-04	0.2
MASONRY	1E-08	0.002
PRE-HISTORIC SITES		
MASONRY/STONE-ROOF INTACT	0.06	1.3
ADOBE - ROOF INTACT	0.01	0.6
MASONRY/STONE-NO ROOF	0.01	0.5
ADOBE - NO ROOF	9E-04	0.2
SEISMICALLY - SENSITIVE AREAS		
AVALANCHES - LOOSE SNOW	0.007	1.1
EARLY AMERICAN/PETROGLYPHS/CAVES	8E-05	0.03
AVALANCHES - SLAB	9E-06	0.02
LANDSLIDE AREAS	7E-15	1E-06

(1) Probability of damage occurring in one structure lying within ± 1.56 mi (± 8250 ft) of nominal MTR track centerline.

(2) Probability of damage occurring in one structure lying within ± 0.4 mi (± 2060 ft) of nominal track centerline.

* Average for 4,000 operations/yr of any one of the 4 types of bomber aircraft listed on Table 1 of Appendix E.

** Average for 4,000 operations/yr of any one of the 4 helicopters listed in Table 1 of Appendix E with a gross weight > 20,000 lb.

of 1 chance in a million, or less, of sustaining damage to any one structure in this category.

For historic sites, weakened (i.e., already cracked) Type B windows and plaster walls on wood frame buildings are the most susceptible to damage with values for the operations-weighted composite probability of damage of 0.04 to 0.06 (4 to 6%). Due to their lower assumed strength, damage potential for sensitive historic adobe buildings is substantially greater than for such structures (presumable occupied) in rural areas but is still quite low—on the order of 0.02%. Masonry historic structures are, as expected, still very resistant to damage. POD is less than 1 chance in 100 million.

Prehistoric structures with intact roofs are estimated to have the highest damage risk and the values are in the range of 1 to 6% for each such structure. Prehistoric masonry structures without a roof have nearly a comparable damage potential. In general, these predicted values of the probability of damage, while low, indicate that such areas should be avoided for MTRs for bomber aircraft wherever possible since the structures cannot be realistically repaired if damage does occur.

Finally, for areas subject to seismic response from noise of MTR bomber aircraft, there does not appear to be a serious problem since the most susceptible "structure"—snow slopes for which loose snow avalanches are possible—have only about a 0.7% chance of being triggered in any one area after 4,000 flights. This type of avalanche is not considered a serious source of structural damage. For the other "structures", the probability of damage to archaeologically significant Early American sites, such as locations of petroglyphs or caves is very low—less than one chance in 10,000. Triggering of a slab avalanche has a damage probability that is less by an order of magnitude. The predicted probability of triggering a landslide by noise of MTR flight is so small that it can be assumed to be essentially zero. Even decreasing the soils shear strength by a factor of 5 still left the probability of a landslide being triggered by MTR noise in the category of a negligible risk (e.g., one chance in about 10 million for any one landslide area after 4,000 flights.)

It is important to recall that the total number of possible occurrences of damage must be computed by multiplying the above values for the operations-weighted composite probability of damage by the number of such structures. This number is equal to their density D per unit area times the total land area within the effective damage zone of length L and width equal to 2.5 times the track standard deviation W. For example, consider a 500 mile MTR for a B-1B aircraft with a standard deviation of the aircraft dispersion of 1.25 miles over rural land made up of 640 acre (1 sq. mile) farms. The number of residential farm dwellings within the effective damage zone would be expected to be 2.5 × 1.25 × 500 × 1 = 1,562. If 25% of these dwellings had gypsum board interior walls, then over a one year period with 4,000 flights, all at an altitude of 200 ft, using the number of sortie-weighted composite probability of damage of 0.08 from Table 4.5.4 for this type of structure and aircraft, the number of occurrences of some damage to these interior walls would be 1562 × 0.08 × (.25) or about 31 occurrences within the 1,562 sq. mile "potential damage zone" over a one year period. This would represent less than one occurrence of this type of damage of every 130 flights. It should be noted also that Air Force policy is to avoid human structures by at least 500 ft; thus, these damage levels would not be expected to occur in most actual operations.

This is, of course, only an estimate for the particular scenario described and is not intended to define the number of occurrences of possible damage for any one actual situation. The damage prediction model developed in this report is a conservative one based on the possibility of a peak stress exceeding the *threshold* of damage. Thus, occurrence of damage in the case just described may simply consist of the development of new hairline cracks in the gypsum board interior walls which would be difficult to distinguish from the same type of cracks generated by other causes.

Heavy helicopter operations

For flights of heavy helicopters at an altitude of 50 ft, the predicted probabilities of damage listed in Table 4.5.4 are very high for all but a few of the structures. The values are so high as to indicate that, with a few exceptions, operations of such heavy helicopters at these low altitudes over most types of land areas containing structures is probably not feasible without a high risk of some structural damage. As explained earlier, this high risk situation is due to the very high sound levels predicted to occur for these helicopters in the same low frequency range at which fundamental resonance frequencies of structures occur. It is acknowledged that, unlike the case for predicting structural response to jet aircraft noise, there is very little supporting data to validate these predictions of response to low frequency helicopter noise. However, at least one instance of damage to a picture window due to overflight at 300 ft of a CH-47 helicopter with a gross weight in the heavy helicopter range, has been observed (Schomer 1989). In the absence of more complete validation, the high damage probabilities indicated in Table 4.5.4 for heavy helicopter operations clearly indicate that such operations at very low altitudes would have to be carefully planned to avoid most types of structures. Furthermore, while the estimated probability of a landslide being triggered by such a low helicopter overflight appears to be negligible, the possibility of triggering a snow avalanche by such flights is estimated to be substantial.

4.5.2 Classification of Impacts

Damage events have been compared with other existing man-made or naturally occurring events which expose structures to a wide range of dynamic loads. Events include structural vibration from miscellaneous household activities, vehicle traffic, and natural seismic vibration levels. Structural stress was examined as it results from changes in the temperature and humidity. These results show that changes in these weather conditions can be 3 to 10 times greater than effects influenced by human activity in buildings.

Finally a comparison, with wind loading was performed. Wind loads would be expected to induce substantially higher stresses in windows than would be experienced from most MTR overflights. Again, the possible exception is for overflights at 50 ft of heavy helicopters. However, it is important to reemphasize that while the *composite* probability of damage to windows (i.e., the value for the helicopter track statistically dispersed about the nominal centerline) does not change markedly as helicopter elevation is increased. The actual maximum stress and hence maximum probability of damage for a helicopter directly overhead *does* decrease essentially inversely with altitude. Thus, the maximum stress levels for heavy helicopters flying at 50 ft altitude, which are close to damage stress levels for glass, would decrease by a factor of 2 if the minimum altitude of such helicopters were doubled to 100 ft.

In summary, most MTR noise levels can be expected to produce stresses in buildings that, at their highest levels, may be of the same order of magnitude as those induced by many every day human activities in buildings or from transportation sources. One important exception is that low altitude MTR flights of heavy helicopters can produce substantially higher vibration levels and stresses than are normally experienced. However, even for these types of MTR operations, as well as all others, stresses induced by MTR operations in buildings are expected to be substantially less than the stress that would be induced by design wind loads on buildings. In the case of historic or prehistoric buildings which were not "designed" for specific wind loads, these will still experience and be subject to the continuing possibility of damage from these higher but infrequent wind-induced stresses.

All low altitude airspaces pass over natural or manmade structures which may be subject to some degree of stress resulting from the acoustic excitation generated by the passing of aircraft at low altitudes. To the extent that flight induced stresses are equivalent to or greater in magnitude or number than other stresses on these structures, the longevity of structures may be reduced or the structures may require greater maintenance. The GEIS assesses only subsonic flying; consequently, events associated with sonic booms are not considered.

Assessment of impacts to structures requires a knowledge of noise levels generated by the aircraft propulsion system, dynamic pressures resulting from motion of the aircraft body through the air, and structural response. Aircraft noise levels resulting from low altitude flying were addressed by the Air Force in a 1987 measurement program. In this effort, a wide variety of aircraft were flown as low as 100 to 300 ft AGL over a flat area instrumented with microphones to record sound pressure levels. Results obtained were 1/3 octave band noise levels at frequencies between 50 and 10,000 Hz. These data are included in the NOISEFILE database and are used in the ROUTEMAP computer code described earlier. The second requirement was addressed by a calculation procedure for the lift pulse pressure fields and aircraft wake and trailing vortex pressure fields based on theory and previous experimental measurements. The third requirement was met by adapting structural response models to the specific situations present in low altitude flying operations. These calculations are summarized in the text above (Sect. 4.5.1) and are presented in detail in Appendix E.

Damage potential is ultimately established on the basis of statistical models for the magnitude of structural (stress) response to acoustic excitation and a corresponding statistical model for the damage threshold. Therefore, the approach involves the use of the noise levels generated by aircraft overflights in analytic models which describe the motion of structures. The magnitude of the event is calculated in terms of the aircraft type, the distance from centerline, and numbers of flights. Impacts are defined in terms of measurable effects on structures (although they may be so small as to be unobservable to the unaided eye). In addition, the impact is put into the context of natural events. These relative comparisons assist in understanding the extent of impacts and the types of mitigative actions that may be warranted.

On the basis of the analysis of POD versus aircraft type, it is apparent that only bombers and heavy helicopters are a potential threat to the physical integrity to structures (for the development of fine cracks indistinguishable from normal ageing). Furthermore, only heavy helicopters may induce vibration stresses greater than those experienced during the normal ageing process. Even for these low flying helicopters, the stresses induced are substantially less than those resulting from effects of wind. Therefore, in situations not involving bombers or heavy helicopters, no adverse structural effects are anticipated as a result of low flying activities and it is not necessary to proceed further with any analyses.

For bombers and heavy helicopters, the analysis should proceed as outlined in the previous section (Sect. 4.5.1.2). Assuming the number (4,000 sorties) and altitude of the flights (200 ft AGL for bombers; 50 ft AGL for heavy helicopters) used for this analysis, probabilities of structural damage can be calculated for any of the applicable types of structures (seen in Table 4.5.4). Bomber flights at 500 to 600 ft AGL no longer contribute to structural damage and heavy helicopters lose their effectiveness at 800 to 1,000 ft. Considering typical bomber operations in terms of sortie rates and altitude, it will be essentially impossible to cause adverse affects to seismically sensitive areas, prehistoric and historic sites, and any type of modern structural elements. Large windows and gypsum wall boards are the most sensitive to damage effects. For heavy helicopters, a large number of low altitude flights has the potential to affect most types of structures. Impacts are defined in Table 4.5.5.

Table 4.5.5. Definition of damage threshold for structures[a] based on a years' operation

Type of structure and # of flights		Negligible	Low	Medium	High
Rural building					
Damage probability to single structure		0.01-.04	.05-0.09	0.1-0.4	.5-1
# flights required	bombers	475	2,400	4,750	24,000
	heavy helicopters	1	4	8	38
Historic sites					
Damage probability to single structure		.01-.04	.05-.09	0.1-0.4	0.5-1
# flights required	bombers	475	2,400	4,750	24,000
	heavy helicopters	1	4	8	38
Pre-historic sites					
Damage probability to single structure		.005-.009	0.01-.04	.05-.09	.1-0.5
# flights required	bombers	330	670	3,300	6,700
	heavy helicopters	L.T.1	1	4	8
Seismically sensitive areas					
Damage probability to single structure (avalanche)		.0005	.001	.005	.01
# flights required	bombers	260	530	2,600	5,300
	heavy helicopters	L.T.1	L.T.1	L.T.1	1

[a]Values per year of flying for structures not including windows greater than 50 ft^2. Damage is taken to be the smallest detectable cracks in gypsum or windows. These are hairline cracks indistinguishable from normal aging effects.

4.6 WILDERNESS AND PARKS[a]

4.6.1 Summary of Findings

Wilderness is federally protected land that may only be affected minimally by other kinds of development, including other kinds of recreational use which would endanger its pristine state (see Sect. 3.3.6). Other lands with similar attributes but no legal status as wilderness lands may be used in a fashion similar to wilderness. These include wilderness study areas, national parks and national forest areas, as well as wildlife refuges, scenic rivers, and primitive areas. Impacts identified in this section are generally applicable to the wilderness aspects of these areas, too, except for the more limited legal consequences of formal wilderness status. Wilderness may be impacted in two important ways: through intrusions which violate a sense of isolation and removal from the influences of industrialized society and intrusions which interfere directly with wilderness recreation activities. Important kinds of wilderness recreation susceptible to impact by low altitude flying operations include (1) solitude; (2) opportunities to view, photograph and in some cases hunt, wild animals; (3) assurance of safety to all recreational users; and (4) assurance that federal caretakers can maintain these areas. Because the concerns must be assessed in terms of user/agency context, an assessment of the impacts requires on site analysis of the specific situation.

Of the 12 case studies selected for the GEIS, 5 were identified as having wilderness areas, including the Adirondack State Park, a New York state legislated wilderness area. The number of such areas within a particular airspace varied from 1 to 5. Generally, low altitude flying impacts to wilderness areas, as expressed by federal and state officials, as well as private citizens, were based on intrusion upon the visual and auditory features of wilderness that are important to the perception of wilderness as an area removed from the

[a]This section summarizes the analyses included in the case studies section (Vol. III) and the wilderness and parks assessment (Vol. IV, Appendix F).

influences of industrialized society. Impacts to this sense of wilderness character varied greatly with severity depending primarily on the frequency and altitude at which the planes fly over an area, and secondarily on the size and use of the area itself. In areas where the impact to the sense of wilderness character is high but occurrence is infrequent or over a small area of land, the impact was determined to be low. Impact to wilderness character in these cases would be expected to increase in severity if the number of flights increased. Other impacts, i.e., to wilderness recreational use associated with solitude, enjoyment of wildlife, user safety, and federal caretaker activities, for the same reason will increase with greater frequency of flights if they are already vulnerable to impact but are affected infrequently.

In general, the impacts resulting from low altitude flights are less severe than are many impacts affecting the viability of public lands and their enjoyment. These more serious impacts are related to competition for land use from (1) consumptive uses such as mining, timber cutting, and cattle grazing and (2) other kinds of recreation, such as civilian flights and off-road vehicles.

Wilderness character

Wilderness character concerns are manifested by the contradictory nature of low altitude aircraft overflight in pristine and unspoiled wilderness settings. While subject to interpretation, the wilderness definition in the 1964 Wilderness Act (PL 88-577) is the mandate for federal caretaking of these lands as part of the public trust, confers legitimacy to constituencies advocating their protection, and may be used as a baseline for defining any wilderness area. Violations of wilderness character definitions involve aural, visual, and/or physical intrusion into areas that are protected from a significant human presence.

Solitude

Solitude may take two forms: isolation of an individual from all other individuals, and isolation of either an individual or small group from the normal constraints of working life. The existence of wilderness is indispensable to recreational solitude because it: (1) affords an opportunity to engage in rewarding primary group interaction which would otherwise be impossible in normal daily life; (2) provides a non-coercive means of establishing self worth in ways not normally allowable in everyday life; (3) affords a unique aesthetic appeal; and (4) through psychological fascination, provides an individual the chance to escape from the pressures of everyday life and an opportunity for self-directed reflection.

Enjoyment of wildlife

Isolation, solitude, and the pristine nature of the wilderness are complemented by the preservation of wildlife. Wildlife are enjoyed through viewing, photographing and other non-intrusive means, or by hunting either for big game trophies or for general subsistence. These two means of enjoying wildlife conflict and may bring confrontation between advocates for both kinds of recreation. Both groups of advocates, however, share the goal of preserving wildlife habitat both for protection of wildlife and the aesthetic enjoyment of a pristine setting. They also value the goal of protecting wildlife nesting, migration, and staging because they consider these events indispensable to enjoying wildlife. In so far as low flying aircraft can disturb peoples' access to and enjoyment of wildlife, such flying operations are an adverse impact.

Safety

Part of the enjoyment of wilderness is dependent on being free of the kinds of dangers found in civilized society. Thus, while there are ever present dangers to wilderness users from natural elements such as avalanches, falls, and stampeding pack animals, contribution to any of these hazards from the intrusion of low flying aircraft is a potential disruption of wilderness use.

Interference with caretaker operations

In addition to federal caretakers, state and sometimes tribal entities cooperate in the administration and protection of wilderness lands. From the standpoint of recreational users it is these officials who are responsible not only for routine patrolling of these areas but also for taking the initiative in conducting the legally- and legislatively-mandated intergovernmental and interagency relations necessary to maintain the integrity of wilderness lands. Interference with these activities is thus a potential violation of wilderness status and threat to its preservation.

Cumulative impacts

No instances of concurrent airspaces were noted for wilderness lands selected for case study assessment. Existence of concurrent airspaces over wilderness areas and parks elsewhere may increase the impacts simply because more flights and resulting intrusions on wilderness activities would occur. While any estimation of impact level is uncertain, this increase may provoke local and national wilderness advocacy organizations to increase their common cause with other organizations seeking to control acquisition of land and airspace by the military.

Contingent valuation

A nation-wide contingent valuation study was conducted to determine the prevalence of low altitude flying operations in wilderness settings. The study results also provide an indication of the value people place both on wilderness preservation in general and on mitigation of adverse impacts. The survey drew from a sample of 12,000 individuals. A total of 8,900 surveys were returned. Of the 8,900 responses, only 323 people or 3.6% of the total sample experienced low altitude flights in wilderness areas. Forty percent (130) of the 323 people exposed to aircraft overflights reported seeing aircraft "not often during a trip." Only 17.8% or 58 people reported seeing military aircraft "often." A very small number of wilderness or national park users (3.7%) reported actually having changed their trip plans while visiting a national park or wilderness area because they either saw or heard low altitude military aircraft or else anticipated such an event. A representative subsample of 1,008 respondents, including wilderness users and non-users, revealed that less than 30% consider low altitude military flights to be very bothersome. As a quantitative measure, respondents did indicate a willingness to pay for a hypothetical reduction in impacts to wilderness areas in the form of mitigative actions which could include dedicating airspace and land for military use and restricting flights over wilderness areas. Restrictions were preferred that included limiting activities to certain non-critical areas and altitudes within designated wilderness and to certain periods of time. Preference and willingness to pay did not differ significantly between wilderness users and non-users, indicating an overall public value for mitigating the effects of Air Force activities over wilderness areas.

The contingent valuation survey further validated the GEIS case study and literature review results. Respondents indicated that concern for solitude in wilderness settings was the dominant issue, followed by concern for the wilderness character, annoyance from noise, and disturbance of wildlife. Solitude and wilderness character are complex terms whose definition can not be reduced to measures of noise or intrusion.

4.6.2 Classification of Impacts

As a result of GEIS scoping, literature reviews, research, and evaluation of case study airspace locations involving wilderness area overflight, two potential impacts of special concern have been identified and are discussed below. These include violation of the wilderness character of areas protected from a significant human presence and the interference with actual wilderness use including solitude, enjoyment of wildlife viewing, safety, and caretaker operations. Future site specific assessments of military airspace proposals should focus on these concerns. It is essential that site visits be conducted to agencies responsible for administrating wilderness areas (National Forest Service, National Park Service, Bureau of Land Management) and citizens concerned with wilderness preservation with whom they consult, to judge the potential impacts highlighted in the matrix.

Wilderness character

Wilderness character is the pristine quality of an area which provides to the user a sense of removal from the influences of industrial civilization. Flight activities can destroy such a sense by noise intrusiveness and, indirectly, through accidentally or purposefully-deposited detritus on the ground. Other public lands can be similarly affected and areas considered for designation as wilderness can be adversely affected. These issues can be aggravated further by failure to consult adequately with caretaker officials and concerned users. For national parks and forests moreover, how adverse the impacts might be may be dependent, in part, on the numbers of visitors to the affected wilderness area and the level and intrusiveness of low altitude aircraft and the frequency of flights.

Solitude

Solitude can take two forms: isolation of the individual from all other individuals, and isolation of either an individual or small groups from the normal constraints of working life. Noise and/or the presence of the aircraft and their emissions can be significant reminders of other people and of civilization and, thus, can disturb the wilderness experience. Indications of the degree to which solitude may be violated can be provided by federal/state agencies responsible for administering the land. Supplemental concerns can be provided by national advocacy organizations.

Enjoyment of wildlife

Any potential effect on wildlife can, in turn, affect the wilderness user's enjoyment of wildlife. Effects on wildlife enjoyment can be direct, as when an animal runs away during hunting or viewing. The effects can also be more general and affect the wilderness user's access to wildlife, as when a change in migratory path or staging area necessitate greater expenditure of energy and time by the user. Such expenditure increases may be so great as to make such enjoyment impractical or impossible. Results could be important even for species of wildlife which are of little interest to wilderness users. Impacts should be projected on the basis of the numbers and distribution of wildlife species and the numbers and locations of low altitude aircraft expected from the proposed action.

Safety

Threats to safety can take two forms: threats to user safety and indirect effects resulting from rescue and salvage efforts associated with military plane crashes. Hikers, climbers, skiers, and horseback riders see the challenges of wilderness areas as qualitatively different from the dangers posed in urban society, and this is one of the reasons why they seek the wilderness experience. Although the dangers caused by low altitude flying activities may be remote, there are perceived potential risks to hikers, mountain climbers, and skiers from avalanches and startle reactions and to horseback riders from having their horses startled, while these people are engaged in risky wilderness activities. Potential impacts should be assessed on the basis of the amount of resources (e.g., steep mountains, ravines, horseback trails available to wilderness users) and the numbers and locations of low altitude aircraft sorties proposed for the airspace over the wilderness area. Isolation of wilderness areas may pose additional threats to pilots because of increased difficulty involved in rescue efforts.

Interference with caretaker operations

Finally, there may be interference with federal caretaker activities such as patrols, wildlife counts, and fire fighting efforts. Aircraft used in these activities tend to be slow compared with military planes. When the operators are concerned with directing their attention to other activities, routine see and avoid precautions are difficult, and the risk of collision can be increased. Close coordination procedures between the caretaker agency aviation office and the military unit responsible for scheduling aircraft operations usually avoid potential aviation conflicts. Impacts can be judged on the basis of the amounts of resources (e.g., acres of timberlands and numbers of monitored wildlife species) subject to caretaker activities in the wilderness area and the numbers and locations of low altitude aircraft.

4.7 WILDLIFE[a]

4.7.1 Summary of Findings

4.7.1.1 *Direct Impacts*

Low altitude aircraft flight could reduce wildlife populations by causing increased mortality or reproductive failure or by causing wildlife to avoid the area disturbed by such flights. Mortality and reproductive failures are common occurrences in the natural dynamics of wildlife populations, which generally have a reproductive rate sufficient to balance mortality and to maintain a stable or increasing population in suitable habitats. For common, widespread species, low altitude aircraft flight in MTRs, SRs, MOAs, and RAs probably does not have a great enough impact to produce a significant population reduction for two reasons: (1) of the individual animals exposed to low altitude flight, only a very small fraction experience mortality or reproductive failure; and (2) the percentage of the regional population exposed to low altitude flight is too small to constitute a significant effect.

For species that concentrate in certain small areas (e.g., nesting colonies, waterfowl staging areas), impacts of low altitude flight could have a more significant effect than on widespread, more dispersed populations for the following reasons: (1) colonies and other wildlife concentrations often occur in relatively exposed or open areas and are thus more exposed to the sight and sound disturbance of low altitude aircraft; and (2) a low altitude flight over a wildlife concentration would affect a greater proportion of the regional population. Effects could be even more significant for threatened or endangered species, whose regional population numbers are already very low and could be reduced by a

[a]This section summarizes the analyses included in the case studies section (Vol. III) and the wildlife assessment (Vol. IV, Appendix G).

significant percentage if low altitude aircraft caused mortality of or reproductive failure in a few individuals.

If wildlife avoid suitable habitats due to aircraft overflights, the effect on the population is equivalent to the population effect that would be caused by habitat loss (i.e., usually a population reduction at least in proportion to the amount of habitat lost). Similar to cases involving mortality or reproductive failure as described above, the significance of the impacts would be less for common species than for species' concentrations, threatened species, or endangered species.

The available literature (reviewed in Appendix G) is not adequate to define precisely the impacts of low altitude flying on wildlife at the population level; i.e., the occurrence or magnitude of wildlife losses within low altitude airspace cannot be estimated with the precision that one could, for example, estimate population decreases associated with loss of a certain amount of habitat that supports a known number of wildlife. The literature does show, however, that impacts (e.g., a reproductive failure) can be expected to occur at least occasionally in instances involving relatively few individuals. The isolated loss of a few individuals is generally not a significant concern, because wildlife populations usually soon recoup such losses if suitable habitat is available (endangered species can be an exception). In this case, low altitude flying has no long-term impact.

4.7.1.2 *Incremental impacts*

Existing non-aviation impacts

Whatever impacts that may be directly attributable to low altitude aircraft must be considered along with consideration of other adverse pressures on existing wildlife populations. The following section provides this perspective. The populations of many wildlife species across the U.S. continue to decline as a result of constant habitat loss, which by far is today's number one problem in wildlife conservation. Agricultural development and urban growth are the primary factors associated with losses of a wide variety of habitat types. Of the 215 million acres of wetlands in the U.S. at the time of settlement, only 99 million remained in the mid-1970s. Annual losses averaged 458,000 acres from the 1950s to the 1970s, with agricultural development accounting for 87% of the losses (Tiner 1984, Goldstein 1988). Annual losses around 1984 were about 300,000 acres. Most wetland losses have been a result of public policy, implemented at public expense (Allen 1985). Conversion of forests to cropland and intensification of agriculture also have been responsible for the population declines of many upland wildlife species (Brady 1988). Extensive areas of bottomland hardwood forests, which are highly productive of wildlife, have been particularly hard hit by clearing for agriculture (Goldman-Carter 1988). Extensive grazing on private and public lands in the plains states and western states continues to restrict the population levels of many wildlife species of riparian habitats, wetlands, and uplands (Strassmann 1987; Franklin 1988). A number of species have been reduced due to the effect of DDT but seem to be recovering since the ban of this pesticide in the U.S. Many species have become threatened or endangered due to habitat loss, with pollution and human disturbance of breeding areas being less major causes of population decline. Notwithstanding the recent federal enactment of a number of agricultural and wildlife conservation programs (Wildlife Management Institute 1988) the outlook for the future is one of continuing population declines and extinctions due to habitat loss associated with the demands of an expanding human population.

Low altitude flight activities

The Air Force's approximately 800 low altitude airspaces nationwide cover almost one million square miles, which represent about 25% of the total land and fresh water area within the United States including Alaska. The daily average number of sorties is about

2 1/4 for each route and about 18 on each MOA. Although the average number of flights in MOAs are more numerous than those in MTRs, they occur over a wider area and are not concentrated over certain spots or along centerlines as in many MTRs. Thus, individual birds or animals under a MOA may not be exposed to nearby aircraft any more than those under an MTR. MTRs cross each other at many points, and wildlife at such points would be exposed to the flights along both of the crossing MTRs.

Incremental impacts of low altitude flight and non-aviation activities

The principal concern is whether the effects of low altitude flying add significantly to existing stresses (e.g., habitat loss) on wildlife and result in additional long-term reductions in wildlife populations. A significant adverse effect would occur if long-term low altitude flying had a consistent impact (e.g., annual reproductive failure or behavioral avoidance of the flight area) that resulted in a reduced population under the low altitude airspace. Such an effect would be equivalent to and additive with impacts of habitat loss (i.e., permanently reduced populations). No such aircraft impact on wildlife under low altitude airspace has been documented, but no systematic study to detect such impacts has been conducted. Several studies have reported wildlife avoidance of habitats in areas of frequent helicopter flights and/or landings. Overall, available literature (Appendix G) suggests that low altitude flying is not highly disruptive of wildlife reproduction, behavior, or survival and has negligible incremental impact in comparison with other factors affecting wildlife populations. Interviews with wildlife biologists in conjunction with the case studies appear to support these conclusions from the literature, recognizing the limitations of such observations in the absence of scientifically obtained data.

Any impact on threatened (T) and endangered (E) species is a significant concern because of the low population levels of these species. The total population of such species is often less than the human population of a single small town. For example, a few species and their total estimated populations are as follows: wood stork—11,000 breeding adults (Ogden et al. 1987); Eskimo curlew—50 birds (Gollop 1988); whooping crane—170 birds (Lewis 1986); and piping plover—4000 birds (Haig and Oring 1987). Any low altitude flying over breeding areas, nesting areas, or other important habitats of such species could have a serious impact.

Available evidence suggests that impacts on wildlife do not increase in direct proportion to the number of flights over a particular area. The basis for this conclusion is that many wildlife species appear to become accustomed to low flying aircraft (Appendix G). If this is true, an increase in low altitude flight activity, such as development of a concurrent airspace, would generally have less cumulative impact on wildlife than would establishment of a new airspace to support the increased activity.

The results of the 12 GEIS case studies can be summarized in terms of threats to endangered species and other wildlife. For endangered species, a majority (7) of the twelve case studies resulted in impacts that were considered to be low or negligible according to criteria developed for the assessment and discussed in Sect. 4.7.2. The five moderate ratings reflect a combination of the presence of endangered or threatened species, the uncertainty about impacts, and the concern of state officials. For other wildlife, findings are related primarily to the presence of game animals, raptors, and nesting or resident waterfowl as affected by uncertainty of impacts and concerns of state officials. The high number of moderate findings may indicate a need to review airspace for possible conflicts and emphasizes the importance of site-specific analyses of proposed airspace.

4.7.2 Classification of Impacts

As discussed above, wildlife responses to aircraft range from apparent disregard (wildlife in many cases apparently tolerate aircraft without adverse effect) to various fright reactions (e.g., panic fleeing), and vary with species, season, reproductive status, previous exposure to aircraft, aircraft type, distance from the aircraft, and other factors. Low altitude flight could cause wildlife to avoid the disturbed area or to experience reproductive failure, both of which could result in reduced wildlife populations. Sensitive wildlife can be affected adversely by low flying aircraft in cases of relatively severe disturbance or at times when they are particularly sensitive to disturbance. Species of particular interest included threatened and endangered species, raptors, migratory waterfowl, and game species.

Impacts are categorized in Table 4.7.1. The categorization contains elements of both intensity and context. For example, the difference between moderate and high impacts for endangered species relates to the number of breeding individuals involved and the degree of effect on them (intensity). Similarly, the meaning of the phrase "particularly important wildlife" will be conditioned by the situation of a particular wildlife species. A species may be considered important because its range or numbers are limited in a particular state even though it may be common elsewhere (context). For this reason, the concerns of state officials are of particular importance.

Table 4.7.1. Definition of impacts for wildlife

	Definition of impact			
Impact type	Negligible	Low	Moderate	High
Endangered, threatened, proposed, or candidate species	No subject species is present and no impact is expected (e.g., animals not present and no other effects are observable by state wildlife officials). [Note: expectation of habituation not acceptable as a criterion for endangered species.]	Non-breeding animals are present in low numbers. Occasional fright responses are expected to be observed, but with no resulting interference with feeding, reproduction, or other activities necessary to the species survival. No serious concern expressed by state or federal fish and wildlife officials (state wildlife agency, U.S. Fish and Wildlife Service)	Breeding individuals are present. Occasional mortality or interference with activities necessary to survival expected to be observed rarely, but not in such a way as to threaten the continued existence of the species in the area. State or federal fish and wildlife officials express some concern	Breeding individuals are present in relatively high numbers. Mortality or other effects (e.g., injury, physiological stress, effects on reproduction, nesting, or rearing of young) are expected that could threaten the continued survival of the species, causing major concern among state or federal fish and wildlife officials (state wildlife agency, U.S. Fish and Wildlife Service)
Other wildlife [Note: particular species (e.g., caribou) or groups of species (e.g., waterfowl may be designated in specific route analyses]	No particularly important wildlife resources are present and no impact is expected (e.g., no susceptible animals present, animals not expected to show fright responses, animals become habituated, high minimum altitude) or impact is so infrequent that it does not cause concern among state or federal wildlife officials (state wildlife agency, U.S. Fish and Wildlife Service)	No particularly important wildlife resources are present. Occasional fright responses expected to occur, but not so as to seriously affect population numbers of a species or cause serious concern among state or federal wildlife officials	Particularly important wildlife resources are present. Occasional mortality or other effects (e.g., injury, physiological stress, effects on reproduction, nesting, or rearing of young) are expected to occur (such that route adjustments could mitigate the effect), but not so as to cause major changes in animal numbers or habitat use; specific concerns are expressed by state or federal wildlife officials	Particularly important wildlife resources are present. Frequent and persistent cases, involving one or more species, of mortality or other effects (e.g., injury, physiological stress, effects on reproduction, nesting, or rearing of young) in a manner that may lead to decreases in population levels; specific, serious concerns expressed by state or federal wildlife officials (State Wildlife Agency, U.S. Fish and Wildlife Service)

4.8 LIVESTOCK AND POULTRY[10]

4.8.1 Summary of Findings

Published literature on the effects of subsonic, low altitude jet and helicopter flights on domestic fowl and livestock is relatively limited. Aircraft were shown to affect fowl and livestock adversely in some instances when the flights were very close to animals and the disturbance level was very high. Although adverse effects may occur only rarely, they must be anticipated and precautions taken.

Turkey flocks kept inside turkey houses sometimes piled up and experienced high mortality rates due to aircraft noise and a variety of disturbances unrelated to aircraft. Pileups with significant mortality in chickens were not reported, and the growth, egg laying rate, reproductive function, and hatchability of eggs were not affected adversely by aircraft or simulated aircraft noise.

No adverse effects of subsonic flight were reported for dogs, mink, or pigs. Horses and sheep reacted strongly to low altitude aircraft by usually running for a short time, but no injuries or other adverse effects were reported in the literature.

Dairy cows in fields sometimes reacted strongly to low altitude aircraft but soon resumed normal activities. Cows near airfields showed no reduction in milk production compared to cows in areas relatively unaffected by aircraft. Although cattle in fields often appeared to be startled by low altitude flights, adverse affects generally were not reported. Cattle in corrals or feedlots sometimes stampeded when aircraft flew low overhead, breaking through the fences and injuring themselves.

[10]This section summarizes the analyses included in the case studies section (Vol. III) and the livestock and poultry assessment (Vol. IV, Appendix H).

In contrast to concerns for the health of wildlife populations, livestock and poultry concerns center on the financial profits of breeding, raising, and maintaining animals in an artificial environment. The focus of concern is on possible financial losses of the individual farming operation rather than on declines in populations of organisms. "Population" decline or survival of individual breeds of livestock and poultry is not an issue, and habitat loss is not a factor. Consequently, any adverse impact in this sense is not an issue except as it may relate to the individual farmer and the issue of socioeconomics.

The available literature and case study findings suggest that low altitude flying only rarely has significant impacts on livestock or poultry of individual farming operations under low altitude airspace (Appendix H). Such impacts could increase if the frequency of low altitude flying in the airspace were increased, and thus the farmer could experience increased financial losses. The increase might not be directly proportional to the number of low altitude flights, because some animals would probably become somewhat accustomed to the flights. Similarly, losses to multiple farmers could affect the economy of an area. The establishment of new airspace would have impacts on additional farms, and the degree of impact would probably be directly proportional to the amount of land area subjected to low flying aircraft.

In conclusion, the greatest concern for livestock centers on dairy cattle and beef cattle in concentrated situations, such as feedlots. Effects on sheep and horses appear minor, and no effects are reported for dogs, mink, or pigs. For poultry, the greatest concern arises from piling on in turkey flocks; pileups with chickens were not reported and growth and reproductive functions (e.g., egg laying) were not affected.

Results of the case studies conducted as part of the GEIS generally supported findings of the literature review. Except for two case studies, in which impacts to livestock were considered to be moderate, all impacts were judged as either negligible or low. Negligible and low ratings occurred primarily as a result of absence of animal concentrations under the airspaces and lack of concern on the part of officials.

Conversely, moderate ratings resulted from greater concentrations of animals coupled with a degree of official concern. The occurrence of some moderate ratings emphasizes the importance of identifying and analyzing livestock and poultry for each specific airspace proposal, since these populations will vary considerably from one area to another.

4.8.2 Classification of Impacts

Livestock and poultry impacts can be addressed at two levels: the overall extent of the livestock and poultry resource within the entire proposed airspace, and the potential for impacts on individual livestock and poultry operations. First, if important livestock and poultry resources are absent or located in few areas under the airspace, the impacts would be generally inconsequential. There is a potentially high overall impact if resources are present in substantial numbers throughout the area under the airspace. Second, potential impacts on individual farmers could be high if one or more sensitive operations were present anywhere under the proposed airspace. For example, a large turkey farm could experience substantial financial losses if turkeys piled up and smothered as a result of a low flying aircraft. If either level of impact were determined to be high, modification of the proposed airspace is to be considered as a means of minimizing potential impacts.

As with other resources, it is helpful also to describe impacts in the context of their importance to society as a whole. A high impact to a few farmers may be bad for them as individuals but of little real consequence to society since their numbers are so small.

4.9 AIR QUALITY[11]

4.9.1 Summary of Findings

The Airspace Database (see Sect. 1.4 and Appendix A for description) was combined with aircraft engine emissions data to produce nationwide total emissions estimates of each air pollutant of concern for MTRs, MOAs and RAs. For each airspace, the annual emissions from each aircraft type were obtained as follows:

$$\underset{[\text{lb}\backslash\text{hr}]}{\text{Emission rate}} \times \underset{[\text{hr}]}{\text{Sortie duration}} \times \text{Annual \# of sorties}$$

Emission rates for each aircraft type were based on an "intermediate" mode of engine operation (Seitchek 1985). The sortie durations for MTRs and SRs were obtained for each aircraft type by dividing the low altitude route length by the average airspeed for that aircraft. For MOAs and RAs, the sortie durations were assumed to be one-half hour for each aircraft.

The assessment of air quality impacts from low altitude flights (Appendix I) utilized atmospheric dispersion models, together with aircraft engine emissions data. The levels of air pollutant concentrations predicted by these models were far below levels that would cause adverse impacts on health or welfare (see NAAQS in Table I.1). Also, the levels of predicted impact would probably be so low as not to be measurable using standard air pollution monitoring equipment. However, ground-level air pollutant concentrations caused by some low altitude airspaces could consume a substantial fraction (5%-50%) of the PSD Class I air pollution increments, which apply in certain national parks and wilderness areas,

[11]This section summarizes the analyses included in the case studies section (Vol. III) and the air quality assessment (Vol. IV, Appendix I).

international parks, and other areas redesignated from Class II to Class I. The PSD Class I increments were not established as a threshold for potential effects on biota, but rather were set, somewhat arbitrarily, at very low levels in an attempt to maintain pristine air quality.

In order to place air quality impacts of low flying aircraft in a broader context, the estimated national total low altitude emissions for the three categories of airspaces were compared with the total estimated annual man-made pollutant emissions for the nation (EPA 1988) as shown in Table 4.9.1. The comparison indicates that for all pollutants, the nationwide percentage of air pollutant emitted into the lower atmosphere by low altitude military flight operations is well below 1%. Given the very low proportion of low altitude flight emissions to national emissions, the incremental impacts of these aircraft emissions with regard to regional and national scale air pollution problems (e.g., acid rain, regional haze) is clearly insignificant.

Impacts to air quality in the case study airspaces (see Vol. III) were predicted using the dispersion models and methods described in Appendix I. The predicted impacts to ambient air quality for each case study airspace were compared with National Ambient Air Quality Standards (NAAQS-see 40 CFR 50), and Prevention of Significant Deterioration of air quality (PSD) increments (40 CFR 52), which are shown in Table 3.3.9. Air quality impacts were assessed according to the fractions of NAAQS or PSD increments represented by the impacts. No discussion of the impacts on visibility are provided for any case study airspace, because the effects of aircraft exhaust emissions on visibility were judged to be insignificant for all types of military aircraft included in this study. This determination was made in accordance with EPA regulations which define "adverse impact on visibility" (40 CFR 52.21) and was based on the analysis described in Appendix I.

Table 4.9.1. Comparison of estimated low altitude flight emissions and national total emissions

Pollutant	National emissions				Low altitude flight emissions				
	Fuel combust.	Transp.	Other	Total	MTRs	MOAs	RAs	Total	% of Nation.
SO_2	19,000	1,000	3,400	23,400	1	1	1	3	0.01
TSP	2,000	1,500	4,000	7,500	2	1	1	4	0.05
NO_2	11,000	9,400	900	21,300	19	6	7	32	0.15
CO	7,900	46,900	12,300	67,100	5	5	6	16	0.02
VOC	2,500	7,200	11,800	21,500	1	1	1	3	0.01

All table values are in units of thousand tons/year. National total emission estimates were taken from *National Air Quality and Emissions Trends Report, 1986*, EPA-450/4-88-001, Environmental Protection Agency, Research Triangle Park, NC, February 1988.

The predicted incremental air quality impact of each case study airspace (including concurrent airspace traffic) was categorized according to the fraction of the NAAQS or PSD increment represented by the impact. Thus, the impact categories determined for each case study airspace are actually representative of the total ground-level air quality impacts from all scheduled low altitude military training flights traversing the case study airspace.

The air quality assessment for the case study airspaces indicated that incremental air pollutant concentrations from MOAs and RAs would be less than 5% of NAAQS, PSD Class II increments, and PSD Class I increments. Incremental air pollutant concentrations were also predicted to be less than 5% of NAAQS and PSD Class II increments for all case study MTRs and SRs. Maximum predicted pollutant concentrations for some MTRs were in the low impact category (5%-50%) with respect to PSD Class I increments. Only one of these MTRs actually passed over a PSD Class I area.

In addition to the case study analyses, an additional analysis was conducted to estimate the "worst-case" local air quality impacts associated with any existing military airspace in the nation. On an airspace scale, cumulative air quality impacts could be a concern where relatively high numbers of aircraft use the same concurrent segment of airspace. Based on results from the case study analysis, it was concluded that NO_x emissions, compared with emissions of other pollutants, were of greatest concern fc. potential local air quality impacts. It was also concluded from the case study analysis that MOA and RA emissions are of little concern when those emissions are distributed a: an area source. If MOA and RA emissions were concentrated along a particular flight path, the impacts would tend to be higher as with MTRs. Thus, analysis of worst case local impacts focused on NO_2 (all NO_x conservatively assumed to be NO_2) impacts in conjunction with MTRs, particularly for those routes where there were a large number of concurrent routes with relatively high emissions.

The aircraft emissions database and Airspace Database were used to produce a list of all routes ranked by the calculated NO_x (as NO_2) emissions per unit length of route. Several of the routes having the highest emissions per unit length were inspected on the Area Planning AP/1B Charts showing MTRs, in order to determine if any of these routes had concurrent route segments. After summing the emissions for some of the concurrent route segments it became apparent that the concurrent route segment with the greatest combined NO_x emissions per unit length was associated with several converging routes over west-central Nevada, near the town of Fallon. Most of this flying activity is Navy and not Air Force, however.

Maximum potential NO_2 impacts under the above concurrent airspace were estimated using the Single Aircraft Instantaneous Line Source (SAILS) dispersion model and the methodology described in Appendix I. All NO_x emissions were conservatively assumed to be in the form of NO_2. The maximum predicted annual NO_2 concentration was 1.4 micrograms/m^3, which is 1.4%, 5.6%, and 56% of the corresponding NAAQS, PSD Class II increment, and PSD Class I increment, respectively.

There are no PSD Class I areas near this worst-case airspace, and it is highly unlikely that such a high activity airspace would be established over or very near a Class I area in the future. Based on the air quality significance of impact criteria (see Sect. 4.9.2 below) the predicted impact is insignificant (<5%) with respect to the NAAQS. The impact is barely over the 5% threshold for potential significance with respect to the PSD Class II increment. However, because of the conservative modeling assumptions (see above and Appendix I), it is expected that maximum NO_2 concentrations would be insignificant (<5%) even with respect to the PSD Class II increment.

4.9.2 Classification of Impacts

Using the above findings, the following table (Table 4.9.2) was developed to categorize the intensity of air quality impacts generated by engine emissions from low flying aircraft. For most airspaces, the impacts will be negligible as shown by the GEIS analysis. Only if the airspace is an MTR or has similar flight patterns and it intersects a PSD Class I area (Fig. 3.3.9) is an air quality analysis necessary. Over PSD Class I areas, the aircraft emissions are not likely to cause a problem in and of themselves, but they may exacerbate already existing problems. Impacts to air quality are predicted using the dispersion models and methods described in Appendix I.

Table 4.9.2 classifies air quality impact levels according to the fractions of NAAQS or PSD increments represented by the impacts. No discussion of the impacts on visibility are required for airspace proposals because the effects of aircraft exhaust emissions on visibility were judged in the GEIS to be insignificant for all types of military aircraft. This determination was made in accordance with EPA regulations which define "adverse impact on visibility" (40 CFR 52.21) and was based on field observations as described in Appendix I.

The predicted incremental air quality impact for a proposed airspace (including concurrent airspace traffic) is categorized (high, moderate, low or negligible) according to the fraction of the NAAQS or PSD increment represented by the impact. If an air quality impact analysis is necessary (i.e., proposed airspace is an MTR intersecting Class I area(s)), the impacts from concurrent airspace traffic should be accounted for in the air quality impact analysis. Thus, the impact categories determined for each airspace would be representative of the total ground-level air quality impacts from all scheduled low altitude military training flights traversing the proposed airspace.

Table 4.9.2. Definition of impacts for air quality

	Definition of impact			
Impact type	Negligible	Low	Moderate	High
Incremental concentrations of air pollution	Predicted incremental concentrations of the pollutant of concern are from zero to five percent of the applicable NAAQS or allowable PSD increment. Contribution of the new source is minor and no cumulative impact assessment is necessary.	Predicted incremental concentrations of the pollutant of concern are from five to fifty percent of the applicable NAAQS or allowable PSD increment. A cumulative impact assessment is needed to determine if the incremental plus background (existing) concentrations would exceed the NAAQS or PSD increments.	Predicted incremental concentrations of the pollutant of concern are from fifty to one hundred percent of the applicable NAAQS or allowable PSD increment. A cumulative impact assessment is needed to determine if the incremental plus background concentrations would exceed the NAAQS or PSD increments.	Predicted incremental concentrations of the pollutant of concern are over the applicable NAAQS or allowable PSD increment. A cumulative impact assessment is needed to determine the extent to which total concentrations exceed NAAQS or PSD increments.

The intensity and context of impacts are incorporated in Table 4.9.2. Although the categorization is based on quantitative contributions to NAAQS and PSD increments, which is impact intensity, the NAAQS and PSD increments are based on Environmental Protection Agency judgements about the consequences for society of resulting levels of pollution, which is a contextual consideration.

4.10 HEALTH AND SAFETY[12]

4.10.1 Summary of Findings

Non acoustic health effects refer to the risks and potential hazards to people and animals caused by low flying aircraft engaged in specific activities. These activities sometimes involve radio frequency emissions from aircraft or ground based radar systems, laser usage during navigational and targeting training missions, and flare or chaff dispersal during electronic countermeasure training missions. Safety related concerns from low altitude flying operations include aircraft crashes (mid air, ground impact, and bird collisions) and accidental release of ordnance (bombs or missiles) from aircraft.

Radio frequency (RF) emissions

Radio frequency (RF) emissions from aircraft radar systems are of very low intensity. Receptors under low altitude airspace would experience very short duration exposures of low power levels so no radiation hazard exists. RF emissions from more powerful ground based radar systems are below permissible exposure limits set by the American National Standards Institute (ANSI) and Air Force Occupational Safety and Health Standards (AFOSH). Siting criteria and emission level analysis are conducted for site specific

[12]This section summarizes the analyses included in the case studies section (Vol. III) and the health and safety assessment (Vol. IV, Appendix J).

proposals involving radar systems so that exposure levels will be well below accepted standards (see Vol. IV, Appendix J for more discussion).

Laser systems

Some Air Force test/training missions may include laser enhanced navigation or weapon systems. These systems are used only at approved locations under scheduled and controlled conditions. Specific procedures for testing/operation of these systems are set forth in ANSI and AFOSH standards. Most lasing operations are conducted in airspace over DOD owned land and on targets within DOD owned land so that there is no danger to the public. The Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) is used by F-15, F-16, and A-10 aircraft and provides terrain following and infrared imagery to displays in the aircraft. It also provides these aircraft with target acquisition/weapon guidance capabilities using two laser modes, one for combat and one for training (eye-safe). The LANTIRN laser operating in the combat mode is a hazard to eyes at a distance of several miles. Because of the hazard posed by the laser in the combat mode, it will be used only on DOD controlled land under specific safety precautions. The eye safe version of the LANTIRN system is developed for use by aircraft operating on military training routes. Since the LANTIRN training mode laser is the only laser operation currently permitted beyond the borders of DOD land, there are no laser operation impacts associated with the overflight of public and private land by Air Force aircraft.

Chaff and flares

Chaff and flares are released from aircraft during specialized low altitude training missions to deceive tracking radar and heat-seeking guidance systems. Chaff and flare releases are conducted over DOD owned land or non DOD land that has been environmentally assessed for such purposes. Health effects from the use of chaff include the potential for ingestion of aluminum and the inhalation of chaff fibers. The small concentrations of aluminum and fiberglass fibers dispersed in the form of chaff and the wide dispersal characteristics of chaff preclude any potential for harmful exposures by ingestion. Health effects associated with the use of flares include the potential for hazardous dud flares on the ground, vegetation fires, and magnesium oxide emissions. Flare drops over DOD owned land greatly reduce the potential for impacts as public access is prohibited and vegetation is sparse. Flares dispersal over non DOD land assessed for such purposes are equipped with igniter mechanisms that remain with the aircraft and are less hazardous as duds. Minimum flare release altitude is prescribed at 500 ft AGL to prevent the possibility of fire.

Aircraft accidents

Interviews with residents living under the GEIS case study airspaces clearly indicate that the primary safety concern is fear of aircraft crashes. A review of major air mishaps during the last 10 fiscal years involving Air Force aircraft at low altitudes indicates an accident rate of 1.5 per 100,000 flying hours per year. This is proportionate to the accident rate of all Air Force aircraft involved in every type of flying operation. Therefore low altitude flying activity does not result in greater accident potential than conventional military flying operations. In addition, the probability that an accident from flying at low altitudes will injure or kill a person on the ground is extremely remote. During this 10 year period no civilian either on the ground or in the air has been killed as a result of Air Force low altitude flying operations.

4.11 MITIGATION

An important part of the NEPA process is the identification of measures the Air Force can take to mitigate adverse impacts resulting from its actions. There are four categories of measures the Air Force can consider in eliminating or reducing the extent of adverse impacts created by low altitude flying operations. The mitigation categories are discussed below and include:

- general airspace siting policies designed to reduce generic impacts;
- mitigation of impacts by avoidance;
- mitigation of impacts by improved information; and
- mitigation of impacts by compensation.

4.11.1 General Airspace Siting Policies Designed to Reduce Generic Impacts

Generally, the best way to reduce adverse impacts from low altitude flying operations is to avoid flying over sensitive resources in the first place. However, since the Air Force must fly many low altitude sorties over a considerable portion of the land area of the United States in order to maintain combat proficiency, it is impossible to eliminate all adverse impacts. Thus, the initial approach to mitigation should be to site airspace over land areas with relatively few sensitive resources. Normally, the Air Force tries to fly over sparsely populated areas, and this approach is preferred in respect to human impacts in that fewer people are affected by low altitude flying operations. The GEIS established that population density, by itself, does not contribute to the degree of impacts experienced by people living under a low altitude airspace. In other words individuals living in sparsely populated areas are not more or less adversely affected by low flying planes than individuals living in more densely populated areas. This being true, the Air Force likely is following the correct policy in attempting to disturb as few people as possible by flying in remote areas.

In locating low altitude airspace in remote areas, however, the Air Force must also avoid adverse impacts to protected areas. The protected areas are frequently dedicated to wildlife and other natural resource preservation as well as associated human recreational activities, with which low flying aircraft are not compatible. Protected areas normally include national parks, wilderness areas, national refuges, national monuments, and national wild and scenic rivers. These protected areas are typically fairly large and can be identified normally from readily available maps. Other large, specially designated areas such as national forests and Indian reservations, which have multiple use areas that may or may not be compatible with low altitude flying operations, are not as sensitive in a generic sense but require close attention in the scoping and assessment process to ensure that sensitive receptors are avoided.

4.11.2 Mitigation of Impacts by Avoidance

Once a proposed low altitude airspace has been generally defined, it frequently is possible to mitigate impacts by not flying near sensitive resources whether they are wildlife nesting areas, human habitations, cattle feedlots, or other receptors. A thorough public scoping process helps identify these receptors. Mitigation can involve altering the configuration of the airspace or prohibiting aircraft from flying within a specified distance of the sensitive receptor. MTRs and SRs lend themselves well to routing around the sensitive resource, whereas MOAs and RAs have more compact configurations that are less conducive to avoiding such resources. All types of airspace, however, can specify that sensitive sites are to be avoided by low altitude aircraft, as long as the sites are not so numerous as to interfere with training objectives. Impacts to most sensitive resources can be reduced substantially if they are avoided by about one-half mile. Some particularly noise sensitive human facilities, such as schools, hospitals, nursing homes, and outdoor recreational centers, should be avoided by approximately one mile. The airspace proposal can incorporate changes in dimension or prohibitions against close overflights as part of the proposed action, thus formalizing the avoidance of some identifiable impacts through careful delineation of the airspace and specification of flying procedures.

4.11.3 Mitigation of Impacts by Improved Information

The GEIS scoping process that included public officials, Indian tribes, and surveys of people living under case study airspace elicited many comments indicating that adverse impacts can be reduced if the Air Force provided more information to the public about its low altitude flying operations. Citizens tend to be more accepting of the aircraft if they know the reasons for their low altitude flying. Such information indicated to some people that there is a reasonable explanation as to why the planes fly low and, as a result, the sense of uncertainty and even concern felt by some people is reduced. As a part of future airspace proposals, one technique for decreasing adverse social impacts is to distribute information documents detailing what the Air Force wants to accomplish with the airspace. This activity can be carried out in conjunction with scoping meetings. In addition the Air Force can provide news releases to local media.

Another way of providing information to interested parties is to maintain a toll free telephone number through which the caller can obtain Air Force flying schedules for any low altitude airspace in the country. This provision can make other users aware of Air Force activities and can provide them with a means of planning their flights accordingly, being especially attentive to FAA procedures that govern flying in these low altitude airspaces.

4.11.4 Mitigation of Impacts by Compensation

The final category of impact mitigation is compensation for damages. Whereas the other three categories of mitigation seek to reduce impacts before they occur, this category is intended to mitigate adverse impacts in the event they occur.

The Air Force is legally responsible for any damages that can be shown to have occurred as a result of its low altitude flying operations. On a case-by-case basis farmers who can demonstrate that they have lost poultry from aircraft induced piling can be compensated by the Air Force. Land owners who experience property loss from an aircraft accident can receive damage compensation.

The process generally requires that the individual claiming damages contact an Air Force base and request assistance. The Air Force will investigate the damage claim and reimburse the individual, if the claim appears to be justified. The claimant has recourse to the judicial process, if he or she is dissatisfied with the Air Force's response.

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B. Darlene Lasley, B.S. in Business Administration from the University of Tennessee, Knoxville, specializes in the areas of socioeconomic data gathering, social surveys, field interviews, project support, costs analysis, and coordination of scoping and public hearings. She has been employed at ORNL for 6 years and has worked on several environmental impact statements and assessments.

Edward J. Liebsch, M.S. in Meteorology from Pennsylvania State University, specializes in the areas of air pollution, dispersion modeling, and data base management. He is a research associate in the Atmospheric Sciences group, where he conducts dispersion modeling of air pollution emissions and evaluates air quality in preparing environmental assessments and environmental impact statements. Before coming to ORNL, Liebsch worked as an environmental scientist for the North Dakota State Department of Health. He has 7 years of experience and 5 publications.

Thomas W. Mason, Ph.D. in Industrial and Organizational Psychology from the University of Tennessee, Knoxville, is President of Thomas W. Mason Associates, P.C. and currently a Faculty Member at UTK. He assisted in statistical analysis and consultation.

Jay McCain, Attorney-Advisor, AFRCE-BMS/DES, B.A., 1965, Chemistry, University of Washington, Seattle; J.D., 1977, University of Puget Sound, Tacoma. U.S. Air Force pilot 1965-1970. Years of experience—12.

Steve Rayner, Ph.D. in Anthropology, from University College, London, has analyzed global decision making about the greenhouse effect, the conditions for economic activity after nuclear war, the perceptions of radiation hazards in medicine, and the institutional requirements for a future generation of energy technologies in relation to their societal acceptability. He also has investigated the qualification and certification of quality assurance/quality control personnel for the NRC, the social impact of a high frequency radio communication facility, low-level flight paths, and closure of uranium enrichment facilities. He has 11 years experience and has written or edited six books in addition to 41 publications.

John H. Reed, Received his Ph.D. in sociology from Cornell University. He is presently a research staff member and group leader of the Energy and Environmental Applications Group, Energy Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee. He has broad interests in the area of Energy and the environment. Reed is a contributor to numerous environmental impact statements, and has done considerable work in the evaluation of energy conservation programs for the State and Local Programs Branch of the U.S. Department of Energy. He helped to design and conduct a series of workshops on program evaluation for state energy offices. In recent years he worked on the load management portion of the Athens Automation and Control experiment, Athens, Tennessee, a project sponsored by the Office of Energy Storage and Distribution, Electric Energy Systems Programs, U.S. Department of Energy. Most recently Reed has been involved in the design of computer based decision support systems.

Loutillie W. Rickert, B.S. in Chemistry from the University of Kentucky, has performed socioeconomic assessments for environmental impact statements and assessments for U. S. Air Force, Department of Energy, and Federal Emergency Management Administration projects, ranging from synthetic fuels to low altitude flying operations. Secondary interests lie in data storage and retrieval on a national level. Previously, she worked for twelve years as a chemical translator (11 languages) in many scientific and technical disciplines, and as a chemical librarian. She has 13 years of experience and 34 publications.

James W. Saulsbury, M.S. in Urban Planning from the University of Tennessee, Knoxville, specializes in airport land use compatibility planning, military airspace, social impact assessment, and database management. He is employed as a researcher by the University of Tennessee, and has worked as a consultant on the GEIS for two years.

Susan Schexnayder, B.A. in English from Nicholls State University, Thibodaux, Louisiana, specializes in sociolinguistics and ethnographic fieldwork. She is currently pursuing an M.A. in anthropology at Louisiana State University, is employed as a researcher by the University of Tennessee, and has worked as a consultant on the GEIS for one-half year.

Mark Schoepfle, Ph.D. in Social/Linguistic Anthropology, from Northwestern University, conducts social and environmental assessments for the Army Chemical Weapons Demilitarization Project and other projects. He is co-principal investigator for perceptions in risk assessments. He has 11 years of experience and 11 publications.

Martin Schweitzer, M.S. in Urban Planning from the University of Tennessee, managed the evaluation of the Weatherization Assistance Program for the Department of Energy, developed a data base for the U.S. Air Force Generic Environmental Impact Statement, coordinated a social assessment of several U.S. Air Force training routes, and evaluated a variety of energy conservation programs, including solar energy and earth-sheltered housing. He has 11 years of experience and 36 publications and has been at ORNL for 11 years.

Kenneth R. Singel, Major, U.S. Air Force, Program Manager, Airspace and Range Planning, HQ USAF/LEEVX. B.S., 1974 Civil Engineering, Syracuse University. M.S., 1976 Engineering Management, Air Force Institute of Technology. Years of experience: 14.

John K. Sollid, Chief Environmental Protection Branch, AFRCE-BMS/DEPV. B.Arch., 1968, Architecture, Tulane University, New Orleans, Louisiana. He has 16 years of experience.

Louis C. Sutherland, Deputy Director and Chief Scientist at Wyle Laboratories assisted in characterizing the effects of low level aircraft overflights on structures at a level of detail appropriate for use in the GEIS.

Warren Webb, Ph.D., Terrestrial Ecologist/Entomologist, has conducted research on insect populations and communities, concentrating on their roles in ecosystems and relationships with plants. He has participated in impact analyses of nuclear power plants, geopressure and geothermal resource development, synthetic fuels, oil shale mining and processing, uranium mining and milling, and small hydropower development. These research and assessment activities have been conducted in agricultural systems, deciduous and coniferous forests, arid grasslands, and tropical savannas.

Amy K. Wolfe, Ph.D. in Anthropology from the University of Pennsylvania, is investigating public responses to and acceptance of Air Force low altitude training activities. In addition, she is reviewing for the Department of Energy socioeconomic aspects of their planned first high-level radioactive waste repository. She has studied perceptions of industrial risk in community settings, assessed community responses to plant closures, and evaluated the Department of Energy Weatherization Assistance Program. She has 6 years of experience and 22 publications and has been at ORNL for four years.

6. GLOSSARY

AIR FORCE REPRESENTATIVE (AFREP)—An Air Force officer stationed at an FAA regional office and accredited by the Secretary of the Air Force to provide U.S. Air Force liaison to the FAA.

AIRSPACE—A generic term used for all categories of airspace used by flying units and abbreviated as follows: Instrument Route (IR), Visual Route (VR), Slow Route (SR), Warning Areas (W), Restricted Areas (RA)

AIRSPACE MANAGEMENT—The coordination, integration, and regulation of the use of airspace of defined dimensions. The objective is to meet command requirements through the safe and efficient use of available navigable airspace in a peacetime environment.

ALASKA NATIVE CLAIMS SETTLEMENT ACT (Public Law 92-203)—formed by the U.S. Congress in 1971, establishes Alaska Native claims and rights to certain public lands, in lieu of piecemeal claims and settlements.

ALLUVIAL—Relating to sedimentary material deposited by flowing water, as in a riverbed or delta.

AMBIENT AIR QUALITY STANDARDS—Standards established on a state or federal level that define the limits for airborne concentrations of designated "criteria" pollutants (e.g., nitrogen dioxide, sulfur dioxide, carbon monoxide, total suspended particulates, ozone, lead, and hydrocarbons) to protect public health with an adequate margin of safety (primary standards) and to protect public welfare, including plant and animal life, visibility, and materials (secondary standards).

AMERICAN INDIAN—known also as Native American, a term referring to any ethnic group in North American prior to the arrival of Europeans in the 15th Century.

ATTAINMENT AREA—An area that has been designated by the U.S. Environmental Protection Agency and the appropriate state air quality agency as having ambient air quality levels below the ceiling levels defined under the National Ambient Air Quality Standards.

CARBON MONOXIDE (CO)—A colorless odorless very toxic gas that burns to carbon dioxide with a blue flame and is formed as a product of the incomplete combustion of carbon.

CATEGORICAL EXCLUSION (CATEX)—a category of actions which do not individually or cumulatively have a significant effect on the human environment and which have been found to have no such effect in procedures adopted by a Federal agency in implementation of these regulations and for which, therefore, neither an environmental assessment nor an environmental impact statement is required.

COOPERATING AGENCY—Any Federal agency, other than the lead agency, which has jurisdiction by law or special expertise with respect to any environmental impact involved in a proposal (or a reasonable alternative) for legislation or other major Federal action significantly affecting the quality of the human environment.

COUNCIL ON ENVIRONMENTAL QUALITY

DECIBEL—a unit for expressing the relative intensity of sounds on a scale from zero for the average least perceptive sound to about 130 for the average pain level.

DOPAA

DROP ZONES—a training are in which troops, suppliers, or equipment are to be air-dropped from military cargo aircraft.

EIS

ENDANGERED SPECIES—A species that is threatened with extinction throughout all or a significant portion of its range.

ENVIRONMENTAL ASSESSMENT—a concise public document for which a Federal agency is responsible that serves to provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact.

ENVIRONMENTAL IMPACT ANALYSIS PROCESS—The process of conducting environmental studies as outlined in Air Force Regulation 19-2.

FEDERAL REGISTER—An official publication that provides a uniform system for making available to the public regulations and legal notices issued by federal agencies. These include Presidential proclamations and executive orders, federal agency documents having general applicability and legal effect, documents required to be published by an Act of Congress and other federal agency documents of public interest.

FINDING OF NO SIGNIFICANT IMPACT—a document by a Federal agency briefly presenting the reasons why an action, not otherwise excluded, will not have a significant effect on the human environment and for which an environmental impact statement therefore will not be prepared.

IFR MILITARY TRAINING ROUTES (IR)—Routes used by the Department of Defense and associated Reserve and Air Guard units for the purpose of conducting low altitude navigation and tactical training in both IFR and VFR weather conditions below 10,000 feet MSL at airspeeds of 250 KIAS.

IMPACT—An assessment of the meaning of changes in all attributes being studied for a given resource; an aggregation of all the adverse effects, usually measured using a qualitative and a nominally subjective technique.

INSTRUMENT FLIGHT RULES/IFR—Rules governing the procedures for conducting instrument flight. Also a term used by pilots and controllers to indicate types of flight plan.

Ldn NOISE LEVEL—The 24-hour average-energy sound level expressed in decibels, with a 10-decibel penalty added to sound levels between 10:00 P.M. and 7:00 A.M.

LEAD AGENCY—the agency or agencies preparing or having taken primary responsibility for preparing the environmental impact statement.

LOW ALTITUDE TACTICAL NAVIGATION (LATN)—A designated airspace area in which aircrews practice point-to-point navigation below 10,000 feet MSL at speeds of less than 250 Knots Indicated Airspeed (KIAS). LATN's are developed by the Air Force and do not require FAA approval. However, the Air Force must submit environmental documentation, similar to that submitted for MTR proposals, which a LATN is developed.

MIGRATION CORRIDORS

MIGRATORY FLIGHT PATH

MOA—An airspace assignment of defined vertical and lateral dimensions established outside positive control area to separate or segregate certain military activities from IFR traffic and to identify for visual flight rules (VFR) traffic where these activities are conducted.

MTR—A low altitude, high speed training route established according to criteria in the FAA Handbook 7610.4. Routes may be established in accordance with either visual flight rules designated visual routes (VR) or instrument flight rules designated instrument routes (IR).

NATIONAL ENVIRONMENTAL POLICY ACT—The federal law, going into effect on January 1, 1970, that (1) established a national policy for the environment, (2) requires federal agencies to become aware of the environmental ramifications of their proposed actions, (3) requires full disclosure to the public of proposed federal actions and a mechanism for public input into the federal decision-making process, and 94) requires federal agencies to prepare an environmental impact statement for every major action that would significantly affect the quality of the human environment.

NONATTAINMENT—An area that has been designated by the U.S. Environmental Protection Agency and the appropriate state air quality agency as exceeding one or more National Ambient Air Quality Standards.

OVERSTORY—the layer of foliage in a forest canopy.

PREVENTION OF SIGNIFICANT DETERIORATION (PSD)—prevention of significant deterioration regulations, expressed in Public Law 95-95. these regulations are designed to limit air pollution impacts from facilities to a portion of the ambient air quality standards.

PSD CLASS I

RANCHERIA—small settlements of Indians, often involved in ranching, farming or similar land use; many are organized as Indian reservations by the federal government.

RAPTORS—Birds of prey, such as hawks, eagles, and owls.

RESTRICTED AREA—airspace designated under FAR Part 73 within which the flight of aircraft, while not wholly prohibited, is subject to restriction. Restricted Areas are designated when determined necessary to confine or segregate activities considered to be hazardous to nonparticipating aircraft.

RIPARIAN—Of or relating to land lying immediately adjacent to a water body, and having specific characteristics of that transitional area (e.g., riparian vegetation).

SCOPING—An early and open process for determining the scope of issues to be addressed in an EIS and for identifying the significant issues related to a proposed action. Scoping may involve public meetings, field interviews with representatives of agencies and interest groups, discussions with resource specialists and managers, and written comments in response to news releases, direct mailings, and articles about the proposed action and scoping meetings.

SORTIES—one mission or attack by a single plane.

SOVEREIGN RESERVATION—a term emphasizing the status of Indian reservations as governmental entities distinct from state and local government.

SPECIAL USE AIRSPACE—Airspace of defined dimensions where activities must be confined because of their nature, or where limitations are imposed on aircraft operations that are not a part of those activities, or both.

SR—Slow Speed Low Altitude Training Route—A low altitude training route which is used for military air operations at or below 1500 feet at airspeeds of 250 knots or less. Criteria are determined by the responsible MAJCOM.

STATUTE MILE—a unit of measure equal to 5280 feet.

STRATEGIC TRAINING RANGE COMPLEX (STRC)—A Strategic Air Command (SAC) training area located in Montana, North Dakota, South Dakota, Nebraska, Wyoming, and Idaho. The STRC encompasses at least 25 IRs associated with 6 electronic scoring sites [Belle Fourche, Dickinson, Conrad, Forsyth, Powell, and Havre] and numerous portable mini-mute radar sites.

SUBSISTENCE ECONOMY—The method of producing the food or goods necessary to provide a minimal standard of living, as opposed to a market economy in which a surplus is produced for redistribution.

SULFUR DIOXIDE (SO_2)—Compound composed of sulfur and oxygen produced by the burning of sulfur and its compounds in coal, oil, and gas. It is harmful to the health of man, plants, and animals, and may cause damage to materials.

THREATENED SPECIES—A taxonomic group likely to become endangered in for the foreseeable future.

TOTAL SUSPENDED PARTICULATE MATTER (TSP)

TRIBAL SOVEREIGNTY—the limited right of Indian governments (conferred by treaty, executive order, or congressional legislation) to exercise authority over indigenous people who have established their cultural, linguistic, and historic identity.

UNDERSTORY—the plants of a forest undergrowth.

VFR MILITARY TRAINING ROUTES (VR)—Routes used by the Department of Defense and associated Reserve and Air Guard units for the purpose of conducting low altitude navigation and tactical training under VFR rules below 10,000 feet MSL at airspeeds in excess of 250 KTS IAS.

VISUAL FLIGHT RULES (VFR)—Rules that govern the procedures for conducting flight under visual conditions. The term "VFR" is also used in the United States to indicate weather conditions that are equal to or greater than minimum VFR requirements. In addition, it is used by pilots and controllers to indicate type of flight plan.

WILDERNESS AREA—A large tract of public land maintained essentially in its natural state and protected against introduction of intrusive artifacts.

WILDLIFE MANAGEMENT AREA

7. ACRONYMS

AAC	Alaskan Air Command
AF REP	Air Force Representative
AFB	Air Force Base
AFLC	Air Force Logistics Command
AFR	Air Force Regulation
AFRCE	Air Force Regional Civil Engineer
AFRES	Air Force Reserve
AFSC	Air Force Systems Command
AGL	Above Ground Level
AIRFA	American Indian Religious Freedom Act
ANCSA	Alaska Native Claims Settlement Act of 1971
ANG	Air National Guard
ARO	Adverse Reproductive Outcomes
ARTCC	Air Route Traffic Control Center
ATC	Air Training Command
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
CDFG	California Department of Fish and Game
CEQ	Council on Environmental Quality
CVD	Cardiovascular Disease
dB	Decibel
dBA	Decibel based on A-weighted sound level
DNR	Department of Natural Resources
DOPAA	Decision of Proposed Action and Alternatives
EA	Environmental Analysis
EIAP	Environmental Impact Analysis Process
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EPF	Environmental Planning Function
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FONSI	Finding of No Significant Impact
FR	Federal Register
FWS	Fish and Wildlife Service
"G"	Gravitational
GEIS	Generic Environmental Impact Statement

HQ USAF/LEEV	Air Force Directorate of Engineering and Services, Environmental Division
ICDA-9	Ninth Revision of the International Classification of Diseases
IFR	Instrument Flight Rules
IR	Instrument Route
LANTIRN	Low Altitude Navigation and Targeting Infrared for Night
LATN	Low Altitude Tactical Navigation Area
Ldn	Day/Night Noise Level
MAC	Military Airlift Command
MAJCOM	Major Command
MOA	Military Operations Area
MPH	Miles Per Hour
MSL	Mean Sea Level
MTR	Military Training Route
NAAQS	National Ambient Air Quality Standards
NAF	Numbered Air Force
NDW	Nevada Department of Wildlife
NEPA	National Environmental Policy Act
NFS	National Forest Service
NOI	Notice of Intent
NORA	Nevada Outdoor Recreation Association
NPS	National Park Service
NWR	National Wildlife Refuge
PSD	Prevention of Significant Deterioration
RA	Restricted Area
ROD	Record of Decision
SAC	Strategic Air Command
SAS	Statistical Analysis System
SEL	Sound Exposure Level
SR	Slow Route
STRC	Strategic Training Range Complex
T&E	Threatened and Endangered
TAC	Tactical Air Command
TSP	Total Suspended Particulate Matter
USAF	United States Air Force
USDA	U.S. Department of Agriculture
USDOI	U.S. Department of Interior
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
VFR	Visual Flight Rules
VR	Visual Route

8. LIST OF CONTACTS

8.1 CASE STUDY SPECIFIC CONTACTS

IR-700

87 local residents
32 local elected officials (e.g., county supervisors), 8 law enforcement officials, and 15 newspaper editors for the affected counties
S. Browne, New York State Department of Environmental Conservation
D. G. Butcher, New York Department of Agriculture and Markets
K. F. Wich, New York State Department of Environmental Conservation

IR-474

39 local residents
27 local elected officials (e.g., county commissioners), 11 law enforcement officials, and 12 newspaper editors for the affected counties
Audubon Society
Russel Carver, Concerned Tri-State Citizens
Crow Indians
Tom C. Davis, Belle Fourche, South Dakota
Greater Yellowstone Coalition
Anita Johnson, Belle Fourche, South Dakota
Gean Johnson, Concerned Tri-State Citizens
Jim Johnson, Concerned Tri-State Citizens
R. R. Martinka, Montana Department of Fish, Wildlife, and Parks
Dale Morgan, Concerned Tri-State Citizens
Marie Morgan, Concerned Tri-State Citizens
Montana Wildlife Federation
Montana Wildlands Coalition
Montana Wilderness Users Association
Montana Department of Fish, Wildlife and Parks
Native Action
Northern Cheyenne
Northern Plains Resource Council
Northern Lights Institute
F. Petera, Wyoming Game and Fish Department
R. Raisch, Montana State Department of Health and Environmental Sciences

Mark Rambow, Congressmen Tim Johnson's Office
Andrew Reid, Chadron, Nebraska
The United States Forest Service
William Smeenk, Butte County South Dakota County Commissioner
Wilderness Society
Phyllis Young, Standing Rock Sioux Tribe

SR-300

78 local residents
37 local elected officials (e.g., county commissioners), 15 law enforcement officials, and 21 newspaper editors for the affected counties
R. D. Anderson, Nevada Department of Agriculture
Richard Bargen, Gabbs, Nevada
Elizabeth Beale-Clancy, Citizen Alert
P. Bontadelli, California Department of Fish and Game
Grace Bukowski, Western Solidarity
M. G. Burgoyne, Nevada Department of Wildlife
J. Carr, Lake County, Oregon, Extension Agent
Citizen Alert
Albert A. Cox, Reno, Nevada
Brian L. Davie, Nevada Legislative Committee on Public Lands
Mike Del Grosso, Nevada Division of State Lands
R. R. Denney, Oregon Department of Fish and Wildlife
Desert Research Institute
Dan R. Deveny, Gerlach, Nevada
Patrick T. Durland, Bureau of Land Management
Guy Felton, Reno, Nevada
Bill Fuller, United States Forest Service
Bob Fulkerson, Citizen Alert
Dennis Ghiglieri, Reno, Nevada
Linda Hansen, Carson City, Nevada
J. Harlan, Reno, Nevada
Michelle Harlan, Reno, Nevada
David A. Hornbeck, Reno, Nevada
Donald B. Knapp, Bureau of Indian Affairs
W. H. Kosesan, Oregon Department of Agriculture
Rory E. Lamp, Fallon, Nevada
Fallon Shoshone
Intertribal Council of Nevada
Maude McCovey, Hoopa Valley Business Council
Doug McMillan, Reno Gazette-Journal

W. A. Molini, Nevada Department of Wildlife
Nature Conservancy
M. Neuman, California Department of Food and Agriculture
Nevada Outdoor Recreation Association
Nevada Conservation Forum
Nevada Indian Commission
Charles S. Polityka, Department of the Interior
Patricia S. Port, Department of the Interior
Marla Painter, Rural Coalition
Pyramid Lake Paiute
E. H. Robbins, Dixie Valley, Nevada
Ruth Robbins, Dixie Valley, Nevada
William Rosse Sr., Western Shoshone Nation
Judy Schmidt, Reno, Nevada
Sierra Club
Marjorie Sill, Reno, Nevada
Adrienne T. Smith, Sierra Club
Marsha Donaldson Smith, Reno, Nevada
Rose Strickland, Sierra Club
Kathryn Sullivan, N.A.S.A. Johnson Space Center, Houston, Texas
Ed Tilzey, Bureau of Land Management
Frank Torikai, Federal Aviation Administration
Walker River Paiute
Glenn E. Wasson, Western Shoshone Sacred Land Association
Charles S. Watson, Jr., Nevada Outdoor Recreation Association
Western Shoshone Council
Dr. C. R. Swartz, Tetra Tech (Honeywell)
Alyce Williams, Paiute-Shoshone
Yerington Tribe
Yomba Shoshone

SR-771

99 local residents
88 local elected officials (e.g., county supervisors), 17 law enforcement officials, and 21 newspaper editors for the affected counties
H. S. Druckenmiller, Wisconsin Department of Natural Resources

VR-162

56 local residents
21 local elected officials (e.g., county commissioners), 9 law enforcement officials, and 7 newspaper editors for the affected counties
C. D. Travis, Texas Parks and Wildlife Department

VR-1679

115 local residents
57 local elected officials (e.g., county supervisors), 23 law enforcement officials, and 16 newspaper editors for the affected counties
E. L. Hansen, Indiana Department of Natural Resources
R. W. Lutz, Illinois Department of Conservation

VR-245

18 local residents
8 local elected officials (e.g., county supervisors), 3 law enforcement officials, and 2 newspaper editors for the affected counties
Arizona Bighorn Society
Arizona Game and Fish Department
Joni Bosh, Sierra Club
Bureau of Land Management
J. E. Burton, Arizona Game and Fish Department
Merle D. Clure, Federal Aviation Administration
Colorado River Indians
Concerned Citizens
James Currivan, Bureau of Land Management
Ed Gastellum, National Park Service
Gila River Pima
Linda Hagen, United States Fish and Wildlife Service
Intertribal Council of Arizona
Camille Irwin, Bureau of Land Management
Henry Kim, United States Forest Service
Wilmer Lente, Pueblo of Laguna, Paquate, New Mexico
National Parks Service
Nature Conservancy
Navajo
Matt Nozie, White Mountain Apache Tribe
Pascua Yaqui
San Carlos Apache

Rob Smith, Sierra Club
Sam F. Spiller, United States Fish and Wildlife Service
Tohono O'odham
U.S. Fish and Wildlife Service
U.S. Forest Service
Steve Van Riper, United States Fish and Wildlife Service
R. K. Weaver, Arizona Game and Fish Department
Wilderness Society

Gamecock MOA & R-6002

71 local residents
6 local elected officials (e.g., county councilmen), 2 law enforcement officials, and 5 newspaper editors for the affected counties

Tyndall MOAs

125 local residents
22 local elected officials (e.g., county commissioners), 7 law enforcement officials, and 6 newspaper editors for the affected counties
Allen R. Culpepper, Department of Environmental Regulation
Grover Jones, AOPA Florida Representative
A. J. Roberts, Florida Department of Transportation
Rick Smith, Government Analyst, Governor's Office
Roland Zdunek, Coral Springs, Florida

Yukon MOAs

41 local residents
7 elected officials, 1 law enforcement official, and 1 newspaper editor for the affected boroughs
Alaska Department of Fish and Game
Pamela Bergman, Department of the Interior
Bureau of Indian Affairs
Bureau of Land Management
A. Carson, Alaska Department of Fish and Game
Circle Indians
Circle Village Council
Circle Corporation
W. D. Collingsworth, Alaska Department of Fish and Game
Concerned Citizens
Doyon Corporation

Fairbanks Environmental Center
Linda Fogg, Federal Aviation Administration
Paul D. Gates, Department of the Interior
National Parks Service
Ken Rice, United States Forest Service
Tananana Chief's Conference
U.S. Fish and Wildlife Service

8.2 GENERAL CONTACTS

Bob Aegerter, Mt. Rainier National Park Association
Wilbur E. Anderson, President, Dawn Air
Chrys Baggett, North Carolina Department of Administration
Charles Bagley, Jr., Seattle, Washington
Fred Bonner, Outdoor Editor, Capitol Radio Networks
Doug Bowie, United States Forest Service
Michael Bronoski, United States Environmental Protection Agency
Raymond P. Churan, Department of the Interior, Albuquerque, NM
David Crampton, Staff Assistant to United States Senator Tim Wirth
Wayne Deason, Bureau of Reclamation, Department of Interior
Jean Durning, The Wilderness Society
Polly Dyer, Olympic Park Associates
Jim Eychanger, Washington Trails, Seattle, Washington
Bill Flournoy, North Carolina Deparment of Natural Resources and Community Development
Michael A. Fritz, United States Fish and Wildlife Service
Greg Garrett, Western Solidarity-Executive Director
Norman D. Gillikin, Carteret County Crossroads, North Carolina
Charles F. Harris, National Park Service
Shelia M. Huff, Department of the Interior, Chicago, IL
Gerald Kanter, Chairman, Eastern Regional Jetport, North Carolina
Bruce Keleman, United States Forest Service
James H. Lee, Department of the Interior, Atlanta, GA
Ann Lichtner, Policy Analyst, Office of the Governor of North Carolina
Bill Lowery, United States Forest Service
Dennis Luszcz, North Carolina Wildlife Resources
B. A. Moore, North Carolina Forest Service
Ed McCoy, North Carolina Division Marine Fisheries
Anita J. Miller, Department of the Interior, Philadelphia, PA
Bill Moody, United States Forest Service
Tabbie Nance, Beaufort, North Carolina

John R. Parker, Jr., State of North Carolina Division of Coastal Management
William P. Patterson, Department of the Interior, Boston, MA
Stephanie Pollack, Conservation Law Foundation, Boston, Massachusetts
Gerald Pollet, Legal Advocates for Washington
Dale Potter, United States Forest Service
Sally Reeve, Bellevue, Washington
Tom Reeve, Bellevue, Washington
Norman V. Reigle, National Park Service
Marshall Sanderson, North Carolina Department of Transportation
Roger Skistad, United States Forest Service
Clark Smith, Seattle, Washington
Dennis Stewart, North Carolina Wildlife Resources
Robert F. Stewart, Department of the Interior, Denver, CO
Rich Szlemp, United States Fish and Wildlife Service
John Taggart, North Carolina Department of Natural Resources and Community Development
Jeanne Thompson, Seattle, Washington
Tim Thomson, Oak Harbor, Washington
Carol Tingley, North Carolina Division of Parks and Recreation
Mitch Wainwright, Bureau of Land Management

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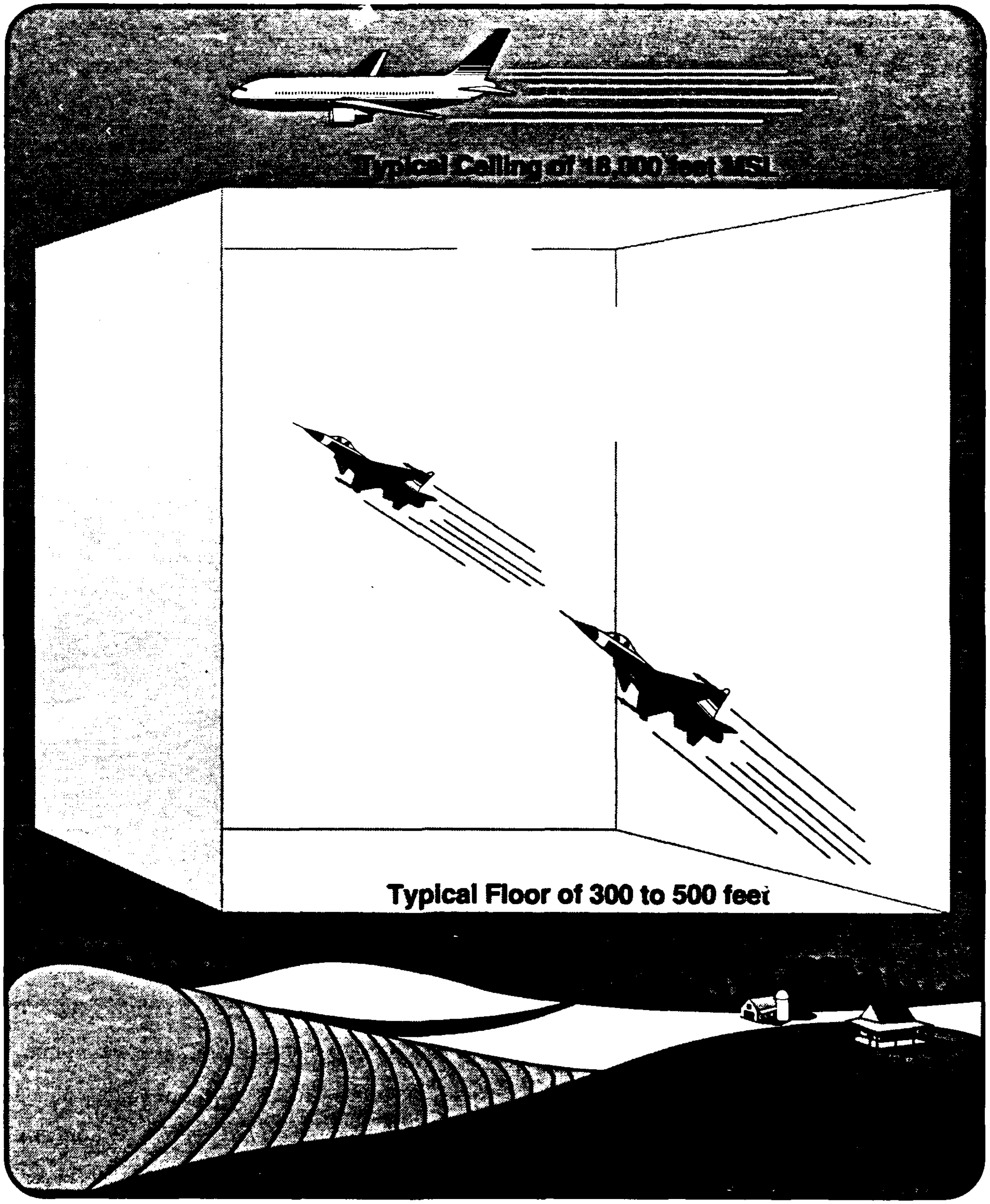

Fig. 1.4.2. Typical Air Force military operations area.

1.4.2 Airspace Dedicated to Low Altitude Flying Operations

In order to develop and maintain the operational readiness of crews and aircraft, the Air Force as of December 1986 operated, either alone or in conjunction with other branches of the military, almost 1000 low altitude MTRs, SRs, MOAs, and RAs throughout the United States. The GEIS analyzes only airspace below 3,000 ft AGL. Subsonic airspace proposals above 3,000 ft AGL have been determined by the Air Force to have insignificant effect on the environment and are usually categorically excluded from assessment under the Air Force's environmental analyses regulation, AFR 19-2 (Attachment 7). Unique circumstances may dictate, however, that the categorical exclusion would not apply to a particular proposed action. Aeronautical impacts such as safety and usage conflicts are determined by the FAA during informal and formal coordination and approval procedures.

In 1986, the Air Force controlled 599 low altitude MTRs and SRs, 126 low altitude MOAs, and 88 low altitude RAs over the continental United States. The availability of these airspaces for Air Force use varies from one day per month to 24 hours every day. Thus, the entire system is not operating at all times. In a typical month that year, there were approximately 20,000 sorties scheduled in Air Force routes, nearly 48,000 sorties scheduled in Air Force MOAs, and over 53,000 sorties scheduled in Air Force RAs.

The Federal Aviation Administration (FAA) is responsible for approving military airspace, setting conditions for its use, and approving flight operations in Instrument Routes (IRs), MOAs, and RAs. By definition, SRs (involving aircraft speeds less than 250 knots) and LATNs (random flight patterns) do not require FAA approval. Airspace has four dimensions: horizontal and lateral (both parallel to the earth's surface),